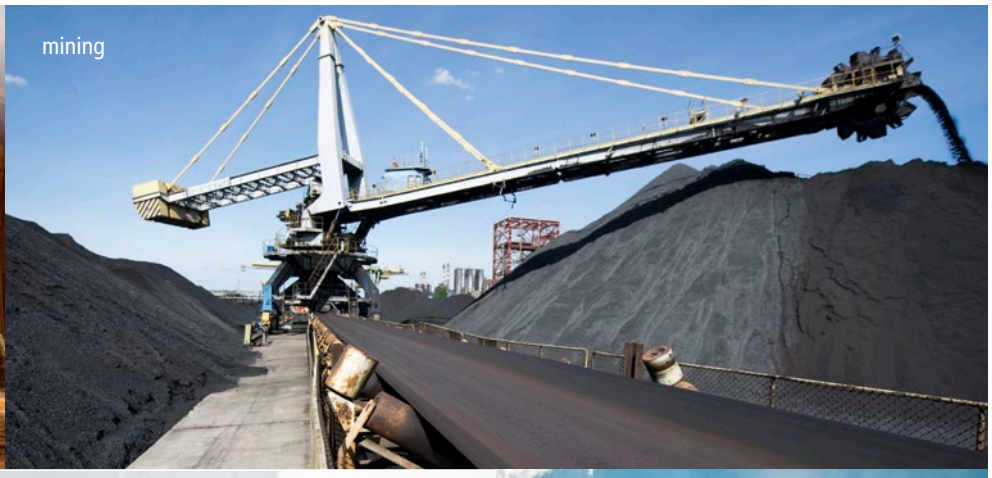
BECKHOFF New Automation Technology

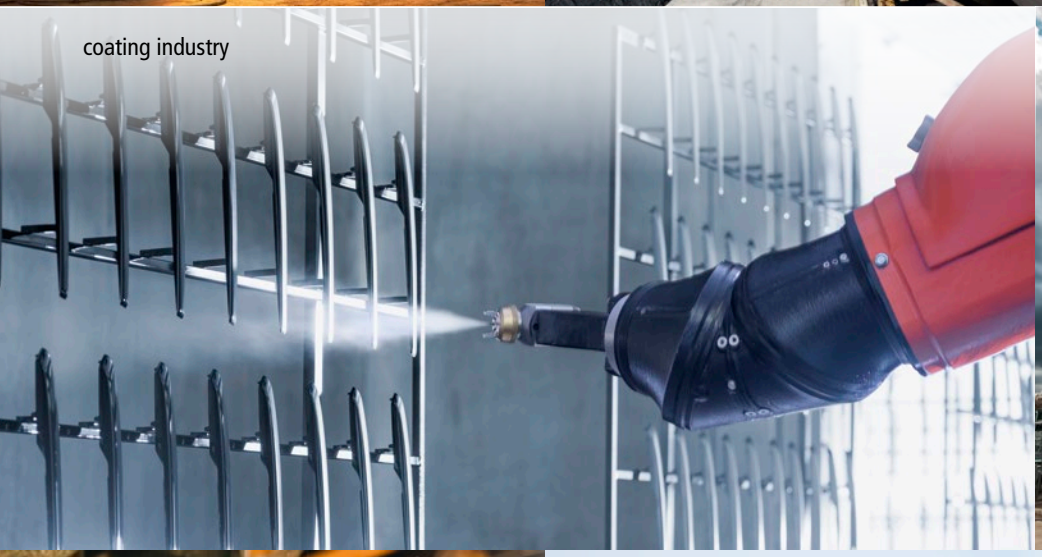
The control system for the process industry: PC-based control

The integrated control concept for all industries with explosion protection requirements

oil and gas production

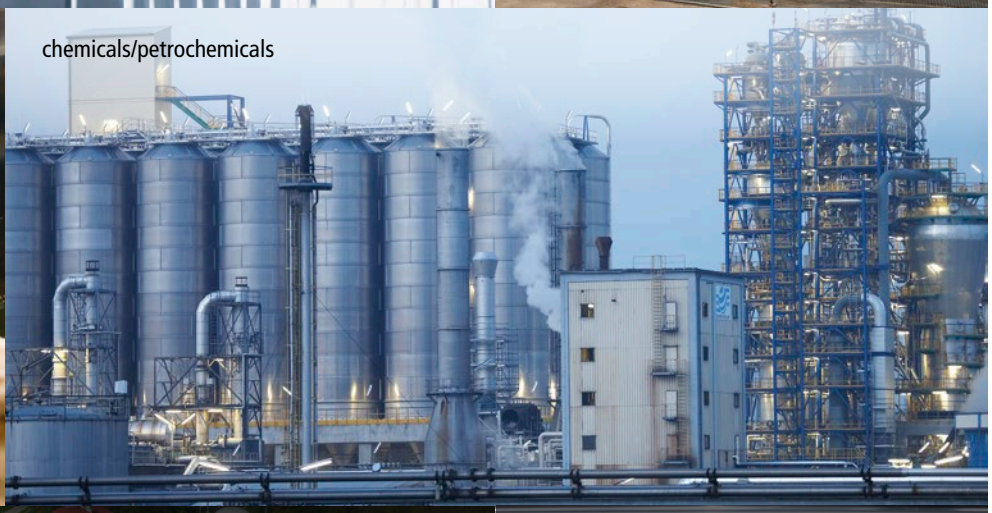

metalworking


mining

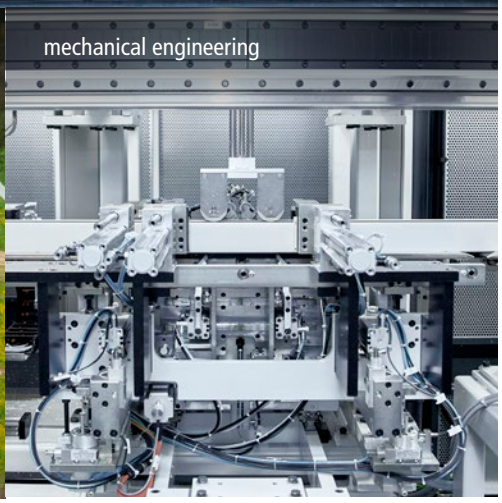

coating industry


energy economy


timber processing

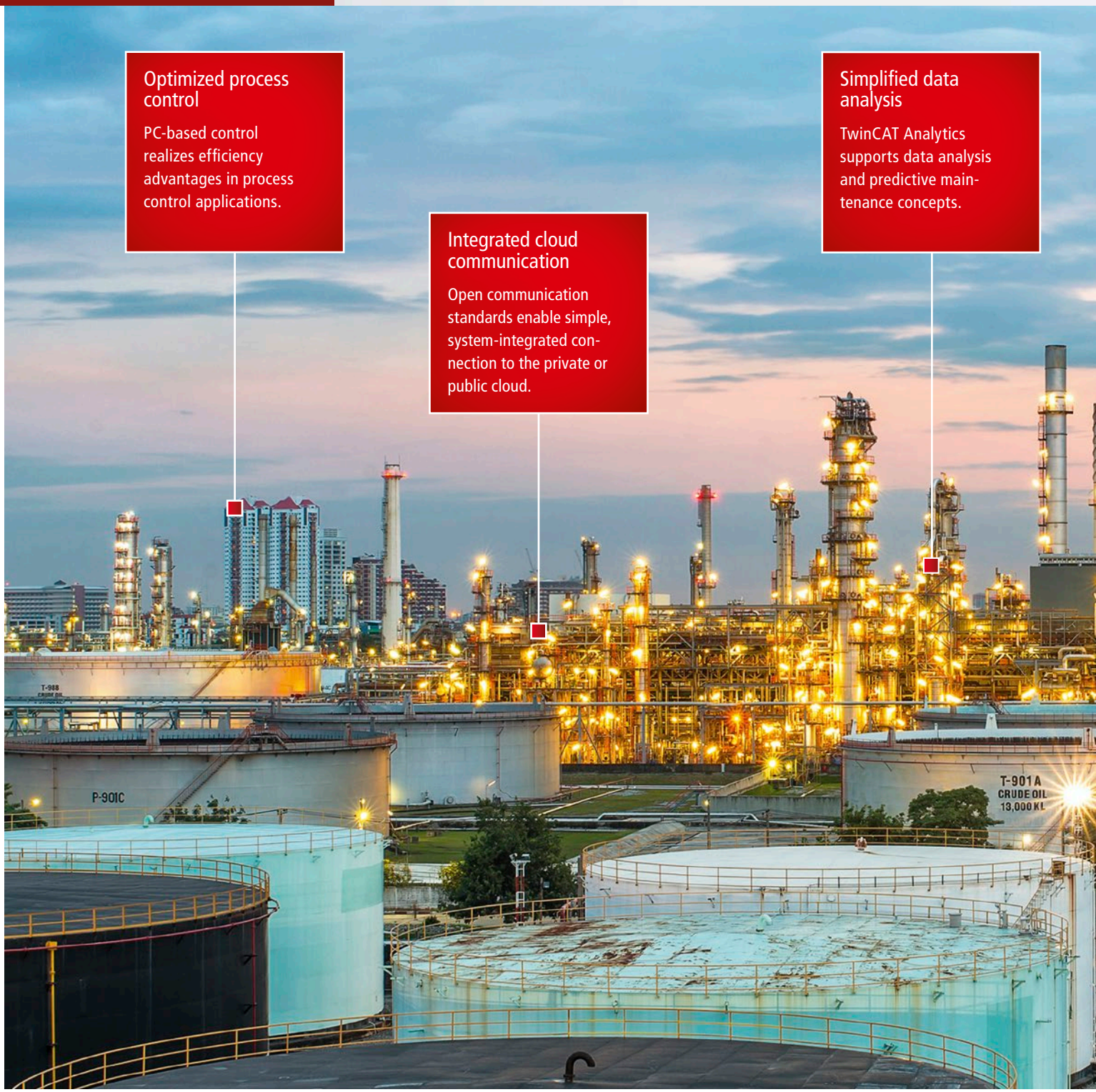

chemicals/petrochemicals


water and waste water treatment


mechanical engineering

PC-based Control: all control tasks on one platform

All-purpose control platform: from explosion protection applications to large-scale process engineering plants
With a universal component construction kit and profound, cross-industry know-how, Beckhoff realizes open automation systems on the basis of PC-based control technology. Through the consistent bundling of control intelligence in the software and the use of established standard technologies from the worlds of IT and automation, PC-based Control combines all functions such as PLC, measurement technology and motion control in a single system. For the process industry, a comprehensive portfolio of explosion-proof components is available for implementing integrated solution concepts for barrier-free communication from Zone 0 to the cloud. These include the EtherCAT Terminals of the ELX series with intrinsically safe interfaces, the Control Panels and Panel PCs of the CPX series with high-quality finish, the TwinCAT control software with specific process technology interfaces, hardware and software modules for simple IoT communication, and the application of cloud-based services and system networking. In the case of new plants, the



explosion protection can be integrated directly into the overall controller; in the case of existing plants the Beckhoff PC-based controller can be simply extended. With the embedding of process-specific interfaces such as NAMUR, HART, FDT/DTM, the standards commonly used in the industry are covered. The full integration of these standards in TwinCAT offers transparency even for users who have previously worked in other software environments. The system-integrated solution from Beckhoff offers an efficient alternative to traditional providers and is suitable for use in numerous industries such as oil and gas production, chemicals and petrochemicals, mining, metalworking, coating processes, timber processing as well as water and energy management.

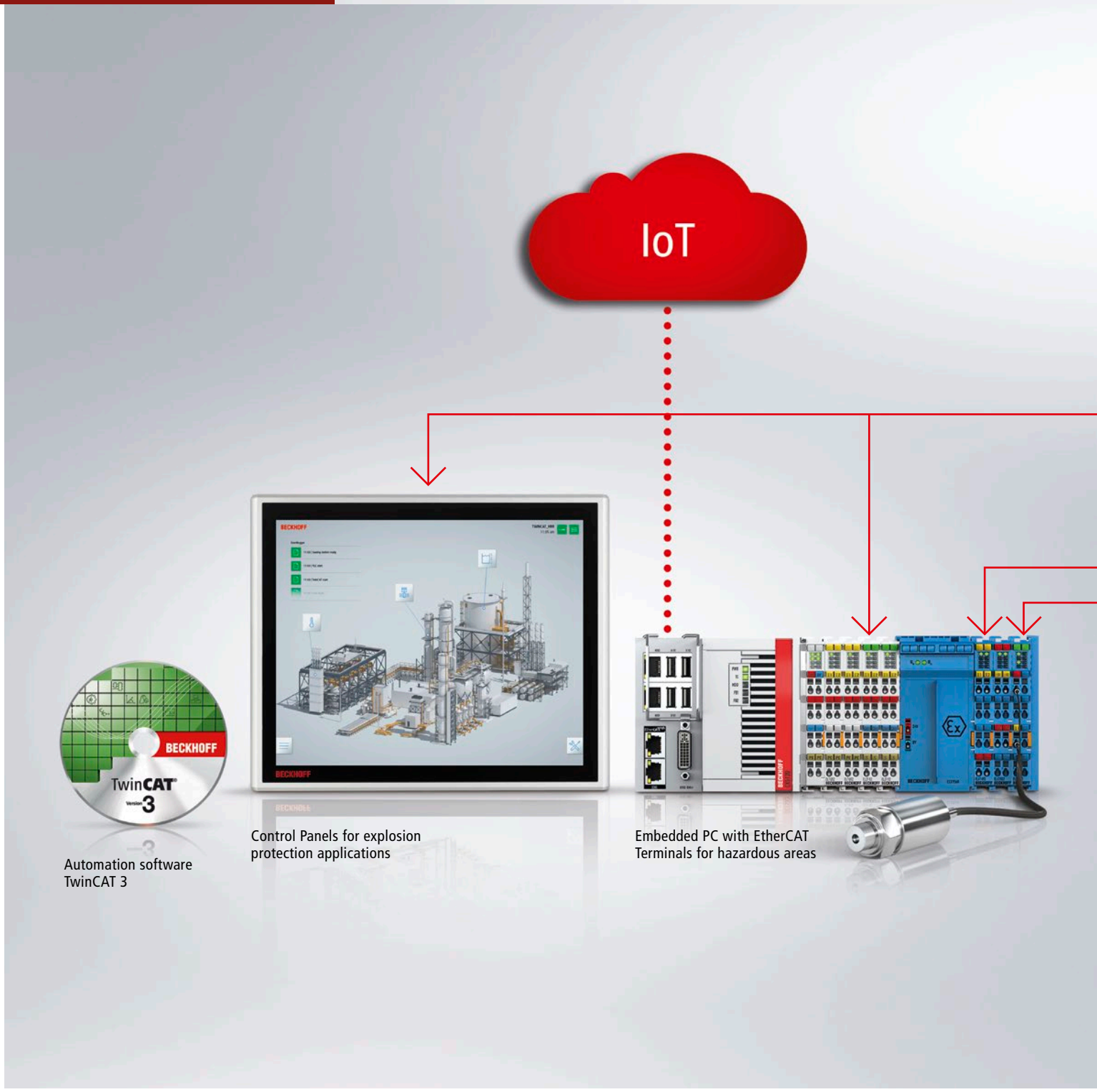
Automation, process engineering and IoT communication in one system:

- integrated hardware and software platform
- barrier-free process technology integration from Zone 0/20 to the cloud
- EtherCAT Terminals with intrinsically safe interfaces, explosion-proof Control Panels and Panel PCs and process-specific interfaces
- PC-based control technology is established worldwide and across all industries

The Beckhoff control architecture: barrier-free from Zone 0 into the cloud

The comprehensive product portfolio for control concepts in the process industry
From barrier-free explosion protection to cloud connectivity: Beckhoff offers an integrated automation concept for different markets and applications in the process industry. Automation, process technology and cloud applications are combined on a single hardware and software platform. In addition to the extensive product portfolio of industrially proven Control Panels and Panel PCs, the CPX series from Beckhoff offers specific solutions for use in Ex Zone 2/22. The EtherCAT Terminals of the ELX series, which have been developed completely in-house, are complex signal terminals for use in hazardous areas. Up to four intrinsically safe inputs are integrated into the 12 mm terminal housing and enable the direct connection of intrinsically safe field devices from Zones 0/20 and 1/21 to the Beckhoff overall control system. The development of customer-specific variants is also possible.

The universal explosion-proof range moreover reduces vendor dependencies: PC-based control integrates all essential automation functions in



Automation software TwinCAT 3

Control Panels for explosion protection applications

Embedded PC with EtherCAT Terminals for hazardous areas

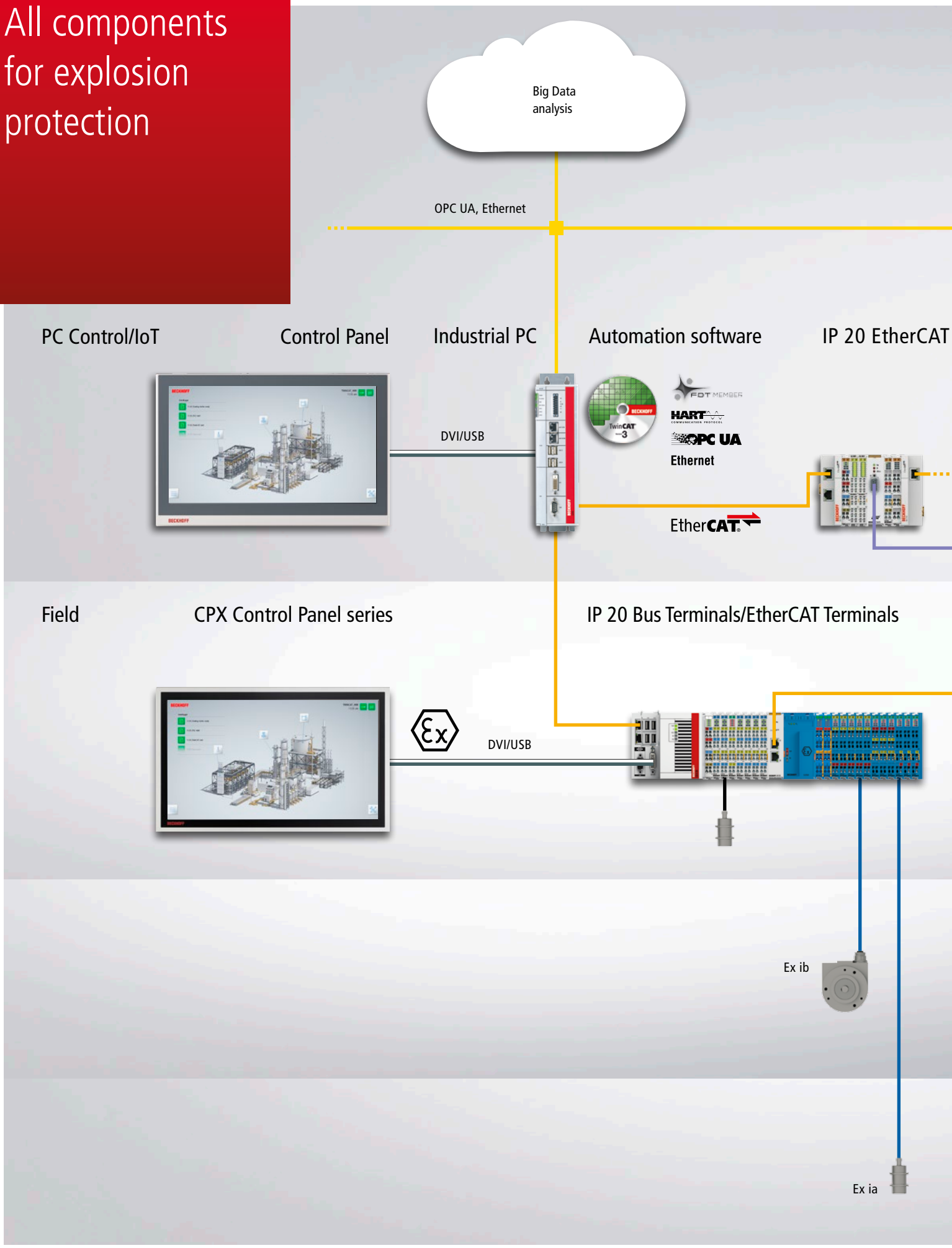
one system. This also applies on the software side: In addition to the HMI and the use of IoT and cloud applications, TwinCAT control software supports NAMUR requirements for digital and analog signals as well as the HART protocol and FDT/DTM technologies. All Beckhoff components meet the requirements of high product, service and delivery quality: on the one hand through production "made in Germany", on the other hand through compliance with comprehensive European and worldwide standards such as ATEX, IECEx and NEC/CEC.

The proven components for PC-based Control: IPC, I/O, Motion, TwinCAT

Barierr-free system integration from Zone 0 to the cloud:

- CPX series: Control Panels and Panel PCs for use in Zone 2/22
- ELX series: EtherCAT Terminal integrates safety barrier in 12 mm housing
- direct connection of intrinsically safe field devices from Zones 0/20
- extensive HART integration
- integration of the FDT/DTM technology
- certification to ATEX, IECEx and NEC/CEC

All components for explosion protection

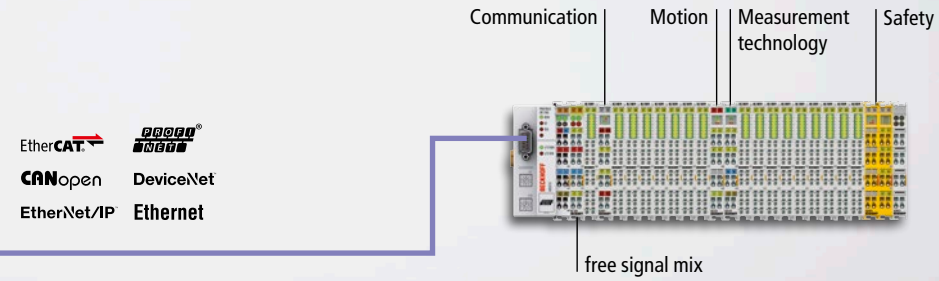


The safe area

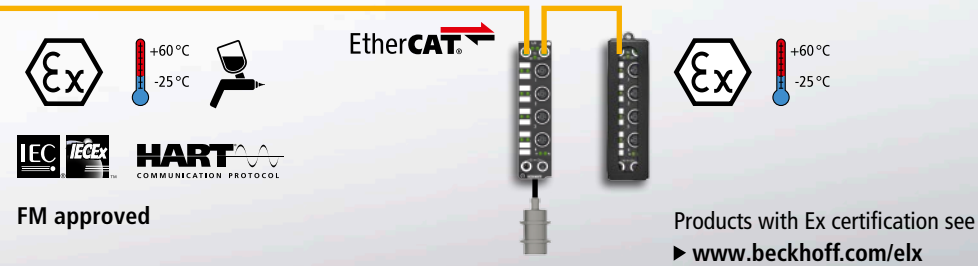
The Beckhoff product range includes all the components required for process automation: from PC-based control and the remote I/O level for all common signal types and bus systems to high-quality IP 65 Control Panels.

Terminals

IP 20 Bus Terminals



IP 67 EtherCAT Box



FM approved

Products with Ex certification see
▶ **www.beckhoff.com/elx**

Zone 2/22

In addition to the IP 20 Bus Terminals/EtherCAT Terminals for control cabinet mounting, Beckhoff also supplies IP 67 modules (for direct mounting in the process environment) for use in Zone 2/22. Products with an increased temperature range and optional coating are available for use under harsh environmental conditions. All components for Zone 2/22 are tested by external certifying bodies.

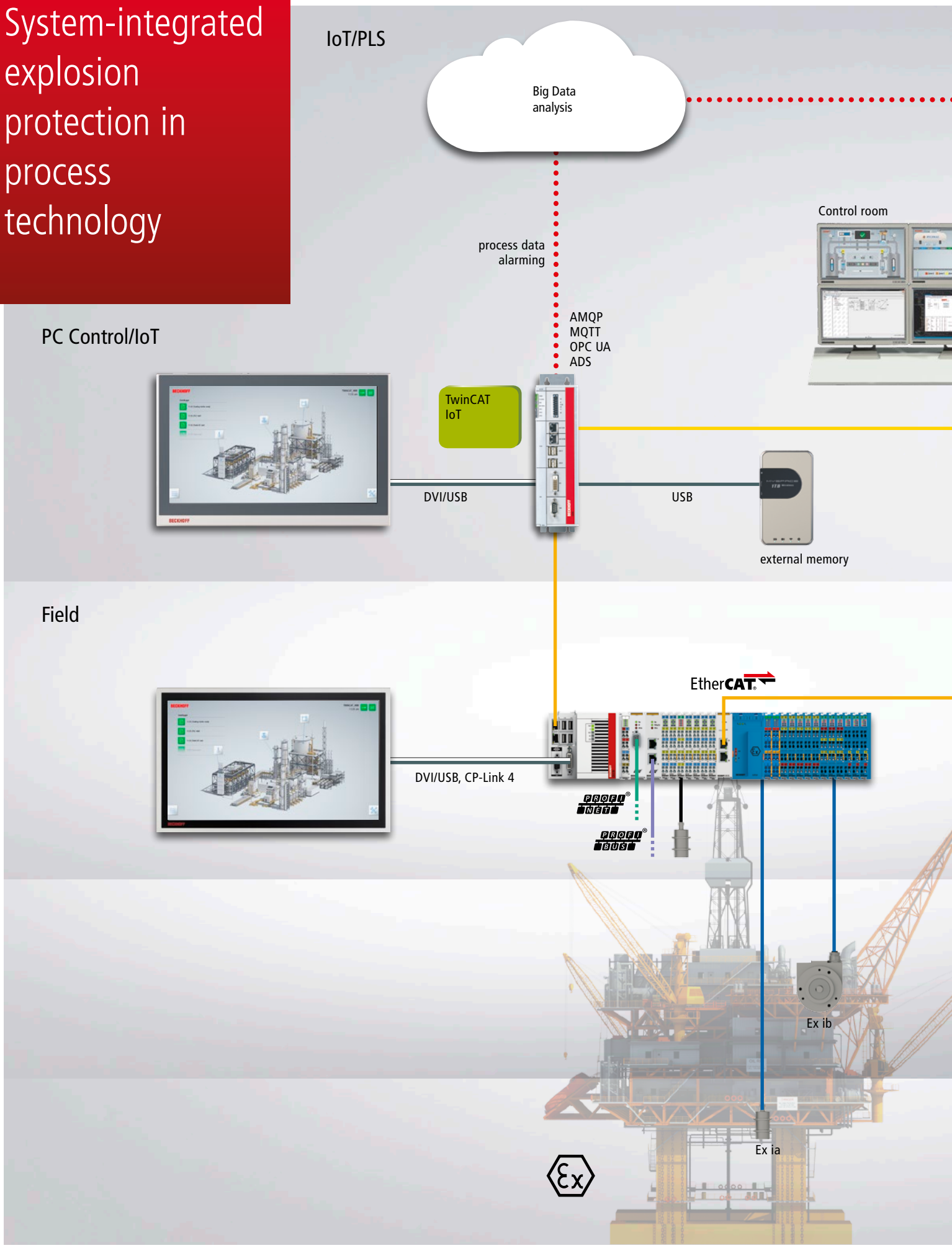
Zone 1/21

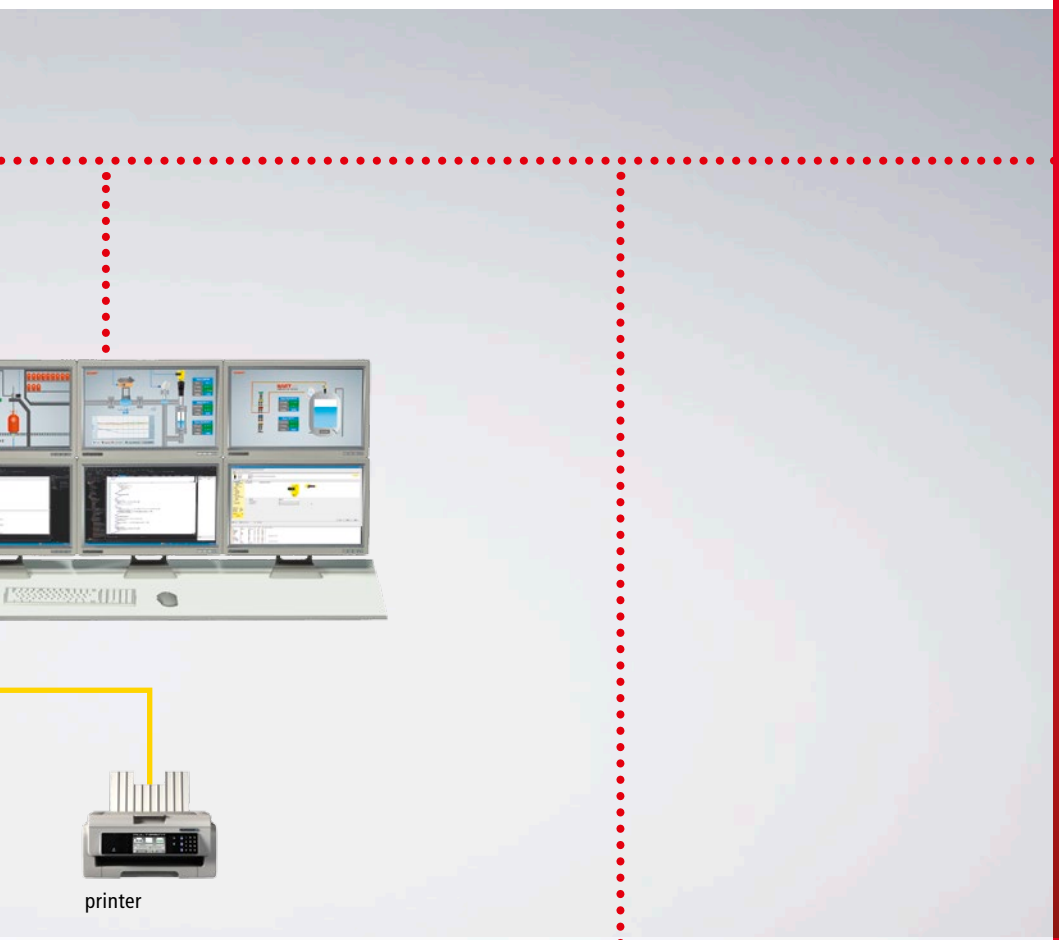
The connection of field devices from Zone 1/21 to the bus system can optionally be accomplished using Ex-d-/Ex-e connection technology or, in the case of intrinsically safe field devices, by means of a direct connection to the terminals from the ELX series.

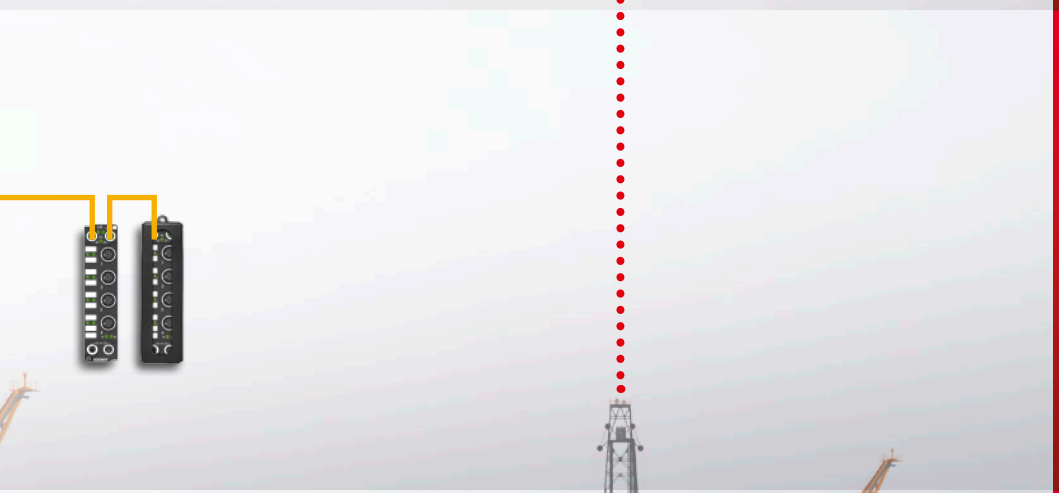
Zone 0/20

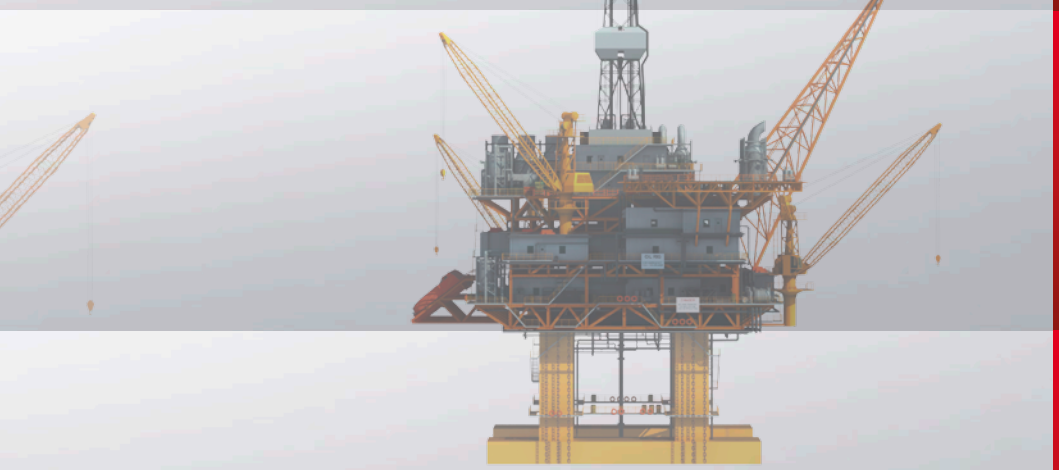
Intrinsically safe field devices in Zone 0/20 can be integrated directly into the automation system via the connection to ELX modules.

System-integrated explosion protection in process technology









The safe area

Whether centralized or decentralized: control solutions on the basis of powerful Beckhoff Industrial PCs enable various control topologies.

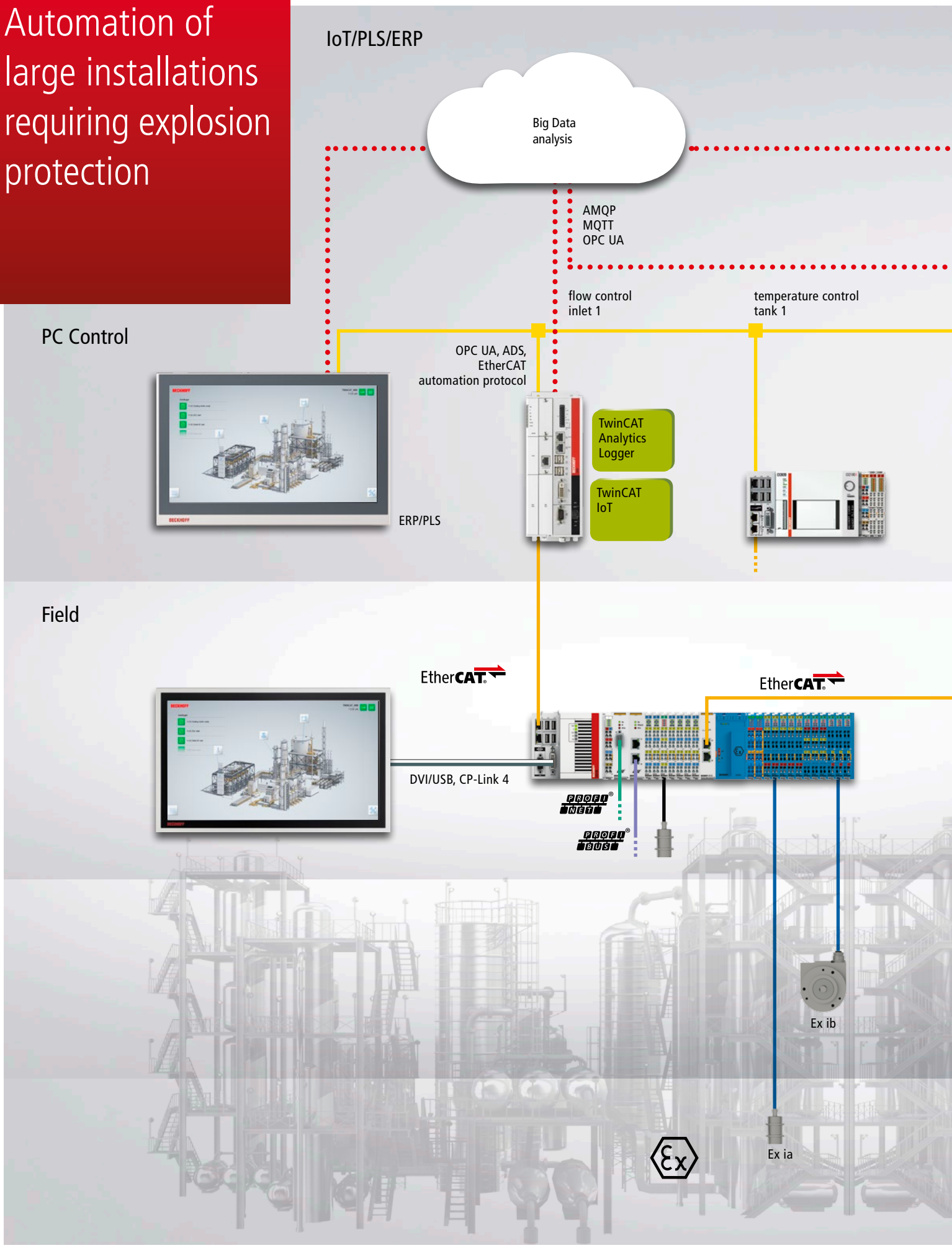
Due to the support of all important communication standards recorded process data can be forwarded to the local control room to be easily visualized or even to be analyzed in the cloud in the central control room.

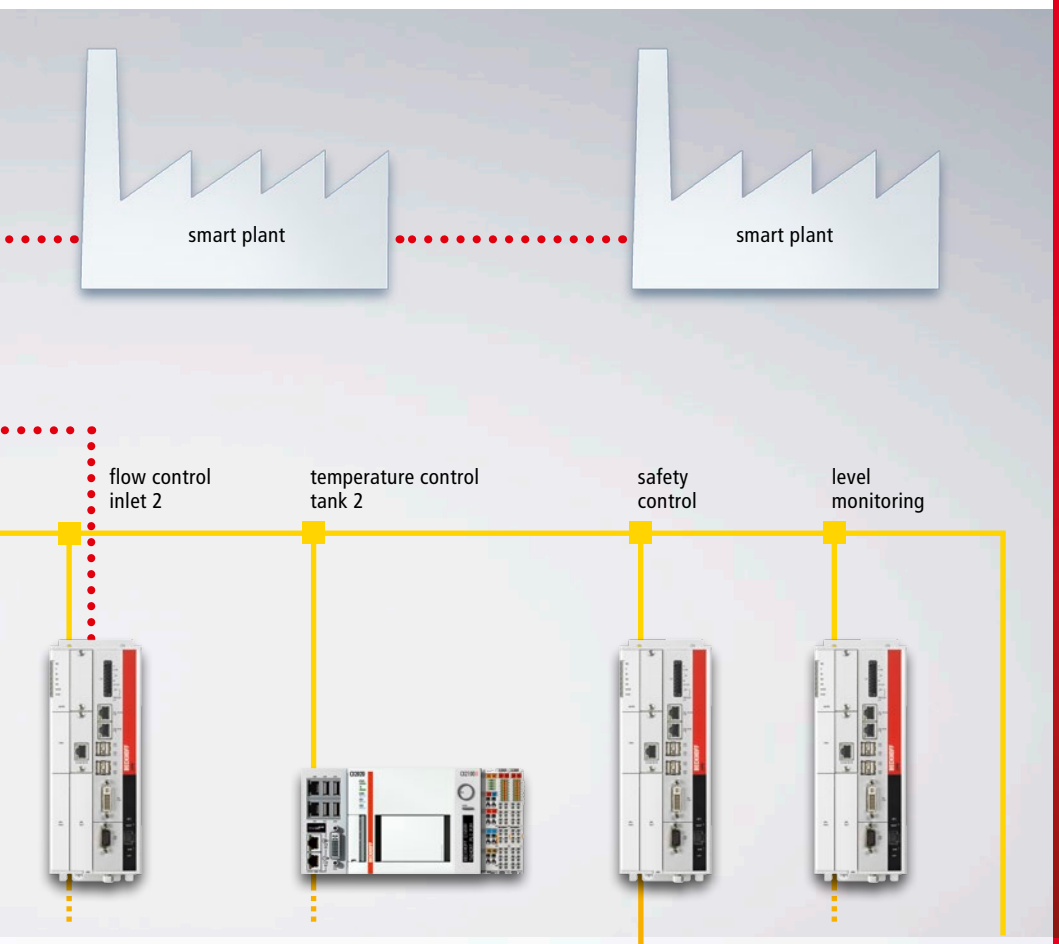
Zone 2/22

Zone 1/21

Zone 0/20

Automation of large installations requiring explosion protection





The safe area

The integrated scalability of Beckhoff control technology enables various decentralized automation solutions. Plant sections can be modularly designed and easily integrated into the comprehensive control system.

Due to diverse connectivity solutions production plants can be easily connected and provide detailed information on the system status to the plant operator at any time.

Zone 2/22

Zone 1/21

Ex ib

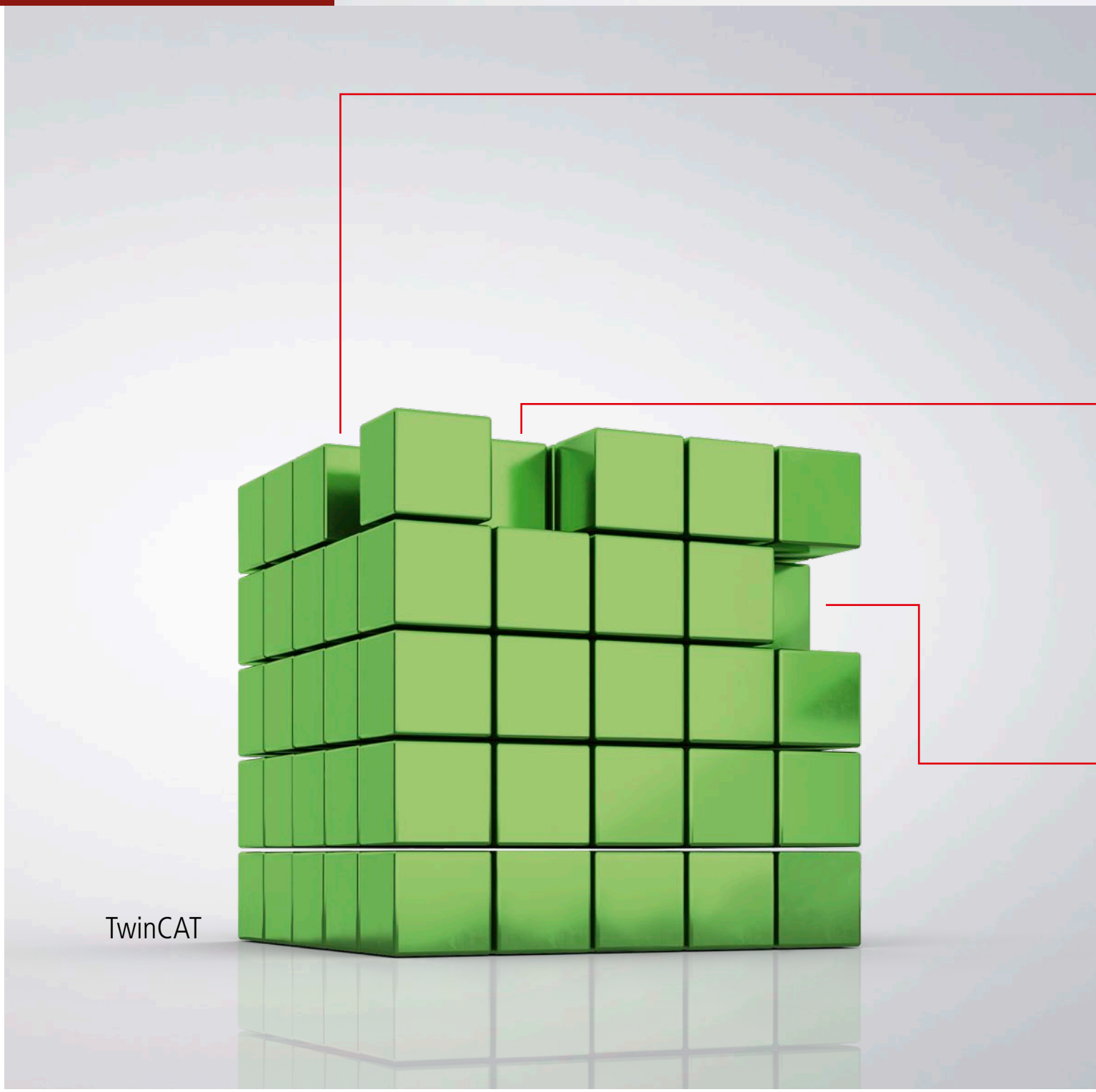
Zone 0/20

Ex ia

Full HART integration and comprehensive libraries: with TwinCAT

TwinCAT: the control platform for process engineering

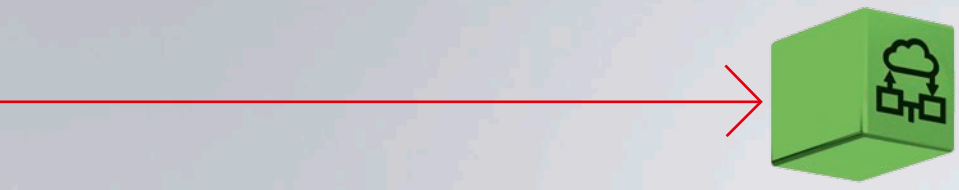
In the TwinCAT control software Beckhoff provides a central platform for the control of even highly complex systems. Apart from classic PLC sequences, algorithms written in C++ or MATLAB®/Simulink® can also be executed in real time. Moreover, TwinCAT includes the HMI, the secure cloud connection via TwinCAT IoT and the use of cloud-based analytical functions via TwinCAT Analytics. The field of application of PC-based Control is expanded with the extensive integration of specific process technology protocols and interfaces. TwinCAT supports all common protocols such as NAMUR, HART and FDT/DTM, covering all application areas. The full integration of the HART functionality both in the remote I/O system and in the TwinCAT Engineering ensures simple project planning and commissioning. HART integration enables users to integrate HART field devices directly into the controller. TwinCAT also reduces the engineering effort: The TwinCAT FDT container allows integration of field device DTMs directly into TwinCAT Engineering and thus a comprehensive HART configuration from one tool. The Beckhoff CommDTM provides for the integration of the TwinCAT controller into existing process control systems. This enables the



parameterization of the field devices in the familiar FDT containers and pares down the plant operation to the essential elements. Global distribution of process data and convenient system control as well as the comfortable remote maintenance are implemented via the Beckhoff OPC UA server and client.

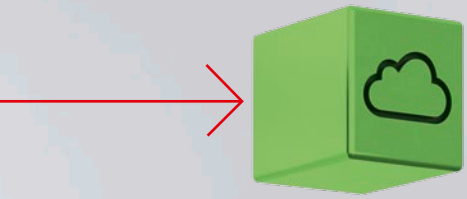
Automation and process technology on a single platform:

- one tool for engineering and runtime
- control-system-integrated Industrie 4.0 and IoT applications
- extensive HART integration
- TwinCAT FDT
- Beckhoff CommDTM



OPC UA

Based on OPC UA (OPC Unified Architecture according to IEC 62541), secure, reliable and vendor-independent communication for transporting process data to the control system is very easy to implement. The use of Beckhoff OPC UA servers and OPC UA clients enables the exchange of data in a secure and reliable way. Data access is controlled via a user management interface in such a way that only authorized users can communicate permissible data securely.

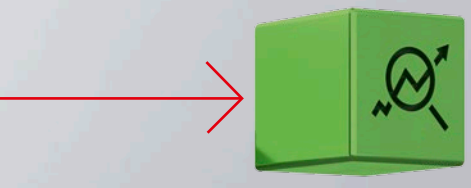


TwinCAT IoT

Beckhoff has developed the TwinCAT IoT software library for the communication between the machine controller and cloud-based services. It supports the standardized protocols OPC UA, AMQP and MQTT for communication with common cloud systems such as Microsoft Azure™, Amazon Web Services and private cloud systems in the company's own network.

Beckhoff CommDTM

Beckhoff CommDTM enables seamless integration of TwinCAT controllers into existing process control systems. DTMs from the field devices connected to the HART-capable EtherCAT Terminals can be integrated in any desired FDT containers with the help of the CommDTM. This allows field devices to be configured and parameterized remotely in the containers without the need for access to the PLC.



TwinCAT Analytics

TwinCAT Analytics enables complete and cycle-synchronous acquisition of all machine and process data. They serve as the basis for extensive analyses, which can be used to realise predictive maintenance to reduce machine downtimes. Moreover, cloud-supported big data evaluation concepts can be created in combination with TwinCAT IoT to ensure sustainable process quality control.

HART und FDT

Thanks to the comprehensive integration of the HART protocol in TwinCAT, the functions from the Engineering interface can be used. The integration of the FDT container enables opening of the field device DTMs within TwinCAT, so that all configuration options are available from one software.

Ideal for process technology: the open EtherCAT high-speed fieldbus

Established across all industries: the high-speed EtherCAT fieldbus

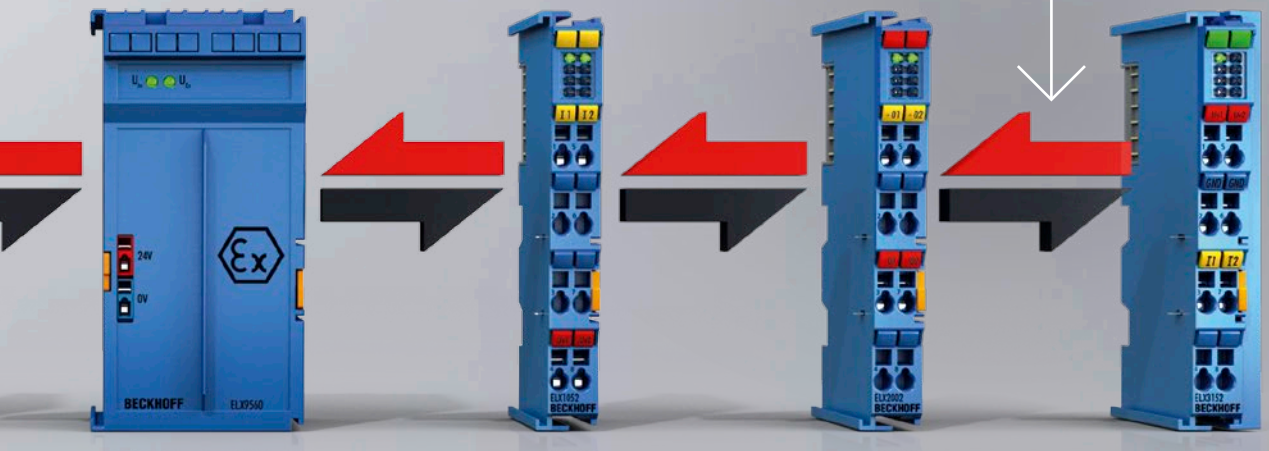
The EtherCAT fieldbus system developed by Beckhoff has been in use around the world since 2003 and is now regarded as the communication standard in many industries: More than 5,535 members* – including over 100 master device manufacturers – have joined forces in the EtherCAT Technology Group, the EtherCAT user organisation. As a universally usable and open high-speed fieldbus for PLC, Motion, I/O sensors, measurement technology and safety technology, EtherCAT is also suitable for explosion-proof connection. In other words, users only need one single communication technology. They can put their trust in the profound know-how of the EtherCAT pioneer Beckhoff and benefit from the safety and flexibility of the universal EtherCAT architecture. EtherCAT-based control systems are flexible and open, permitting the integration of third-party EtherCAT devices as well as many other fieldbus systems. With this openness, EtherCAT optimises existing and new systems alike and ensures investment protection. This is aided by the fact that there is no need to worry about revision control: EtherCAT exists in one version only, which means that new develop-

ments based on EtherCAT are always compatible with older device generations. Users in hazardous areas also benefit from EtherCAT's time stamp functionality, which guarantees high measuring quality and highly precise synchronization – even in extensive systems. Moreover, the EtherCAT concept with a 100 Mbit data rate and complete diagnostics integrated, enables fast error identification in systems and plants: downtime is minimised, while maintenance is simplified and uptime is increased. Via the ELX modules, the full performance of EtherCAT communication is supported right into each I/O terminal. The explosion-proof terminals enable the direct connection of field devices from Zones 0/20, 1/21 and 2/22. Due to the isolation from the fieldbus side, which is fully integrated in every single terminal, the otherwise normally interconnected barrier and thus the second DIN rail in the control cabinet can be dispensed with, which saves further installation work and reduces the system footprint.

EtherCAT optimizes the control architecture in the process technology:

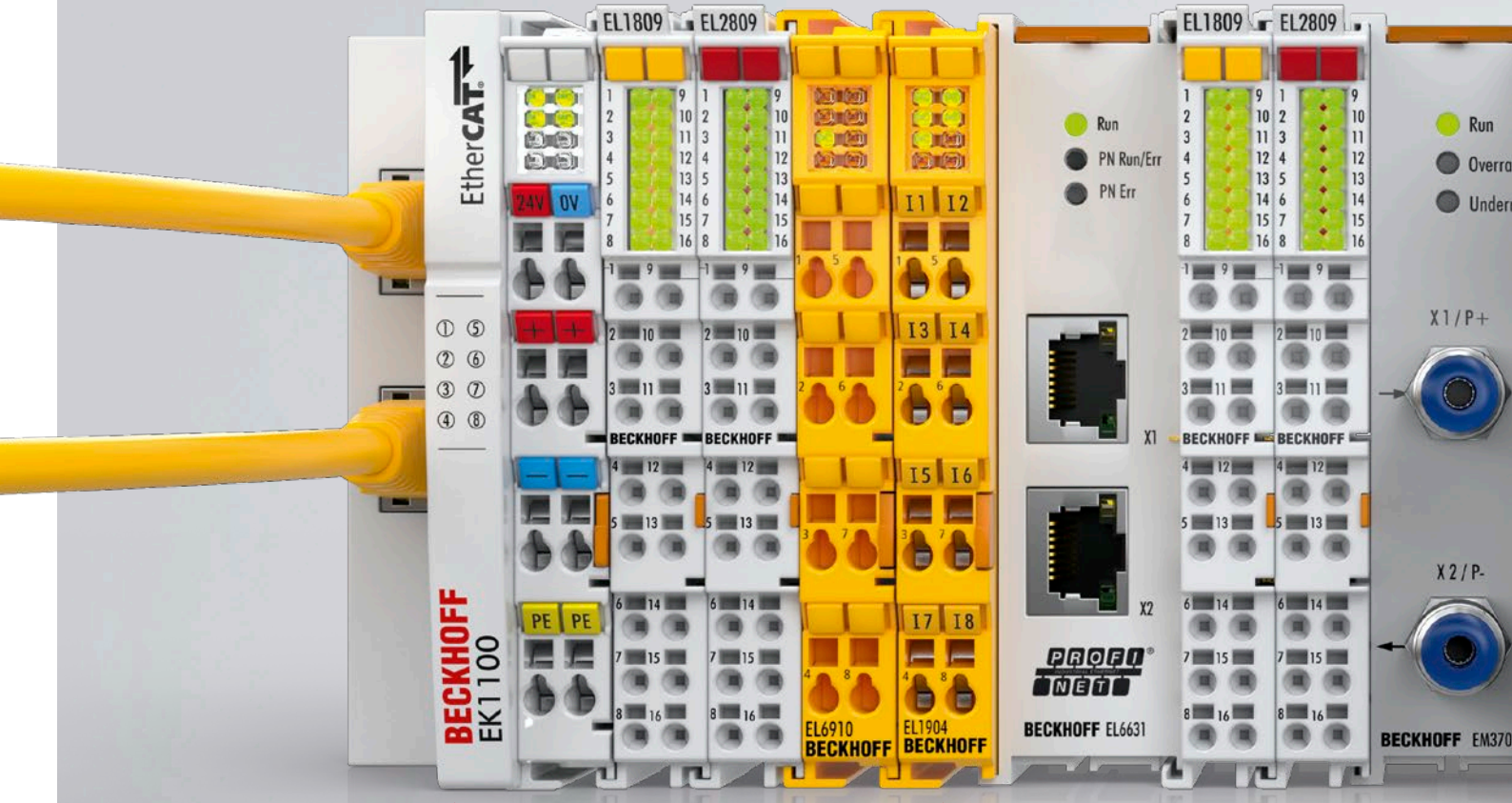
- worldwide established high-speed fieldbus
- only one communication technology for the entire system
- flexible topologies
- complete diagnostics
- implementation down to the individual terminal with ELX modules

EtherCAT – the global communication standard: The EtherCAT Technology Group brings together over 5,535 manufacturers* and users from 65 countries. (*as of November 2019)



Safety, explosion protection, measurement technology: integrated in real time

One platform, one CPU, one bus
One control platform and one high-performance fieldbus for all control tasks. With its PC-based control technology, Beckhoff makes it possible to combine the widest range of I/O components in a single system. With only a single CPU and a single fieldbus, all EtherCAT Terminals for measurement tasks, functional safety and explosion protection can be easily integrated into a comprehensive control system for real-time applications. Users no longer have to rely on multiple standalone solutions, but can benefit from the efficiencies of an integrated solution.

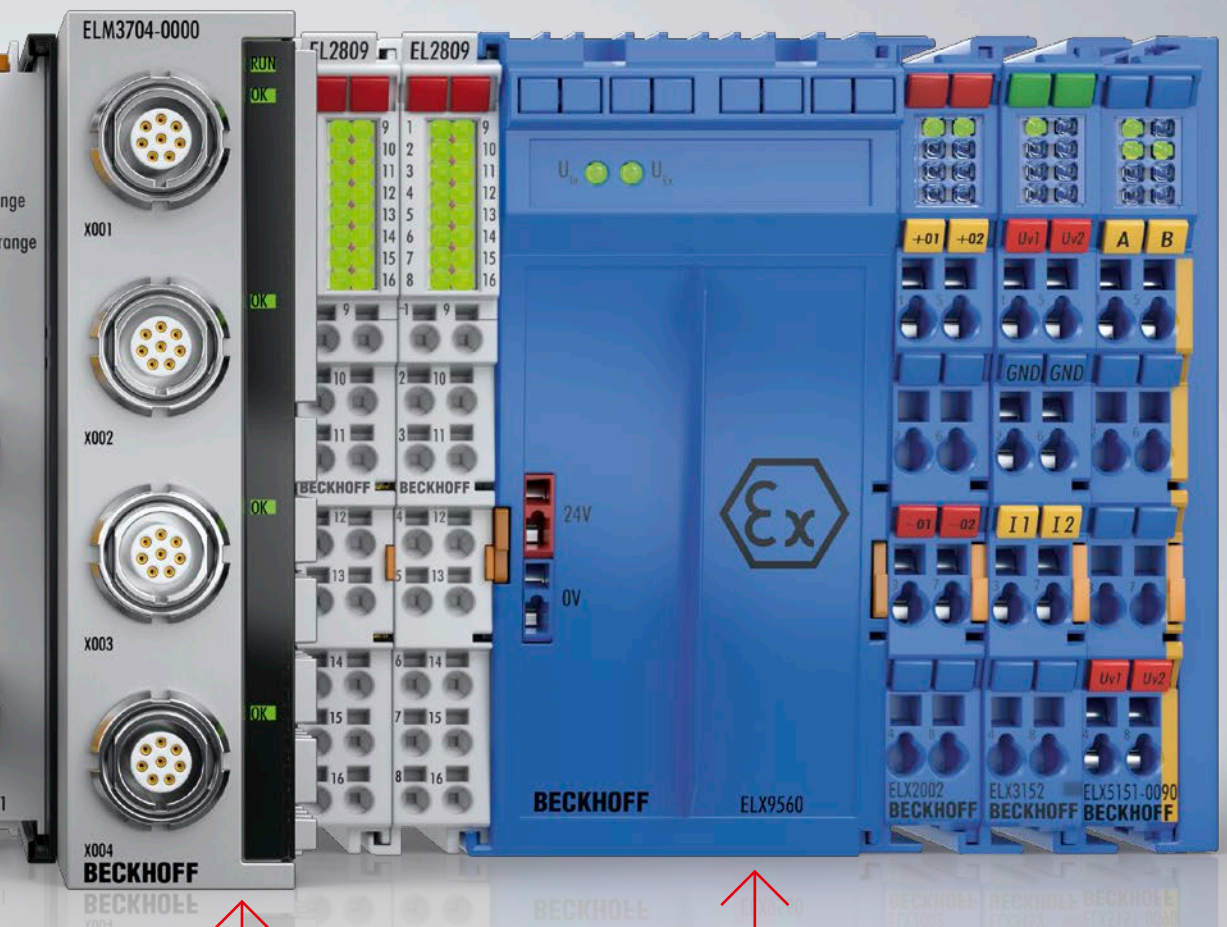


Fieldbus couplers

With controllers or fieldbus couplers, multiple topologies are possible

Safety

Integration of functional safety into the control system with TwinSAFE



Measurement technology

ELM modules in metal housings for precision and high-speed measurement technology

Explosion protection

Highly compact I/O modules with integrated safety barriers for the direct connection of intrinsically safe field devices

Bridges up to 300 m: EtherCAT Extended Distance

Ideal for large and distributed installations
With its Extended Distance technology, EtherCAT simplifies the capturing of data in large and distributed installations such as refineries, water treatment or chemical plants. It does this, for example, with two EK1101-0010 EtherCAT Couplers, whose ports support extended distances. They can communicate over distances of up to 300 m without the need for intermediate infrastructure components. The Couplers accept standard EtherCAT Terminal blocks. With the EK1121-0010 terminal module users can also integrate an Extended Distance branch directly into the terminal segment and connect a remote I/O station. Due to its compatibility with standard EtherCAT devices, the Extended Distance technology does not place any extra demands on the system topology, which makes it possible to configure the EtherCAT network simply based on individual requirements.

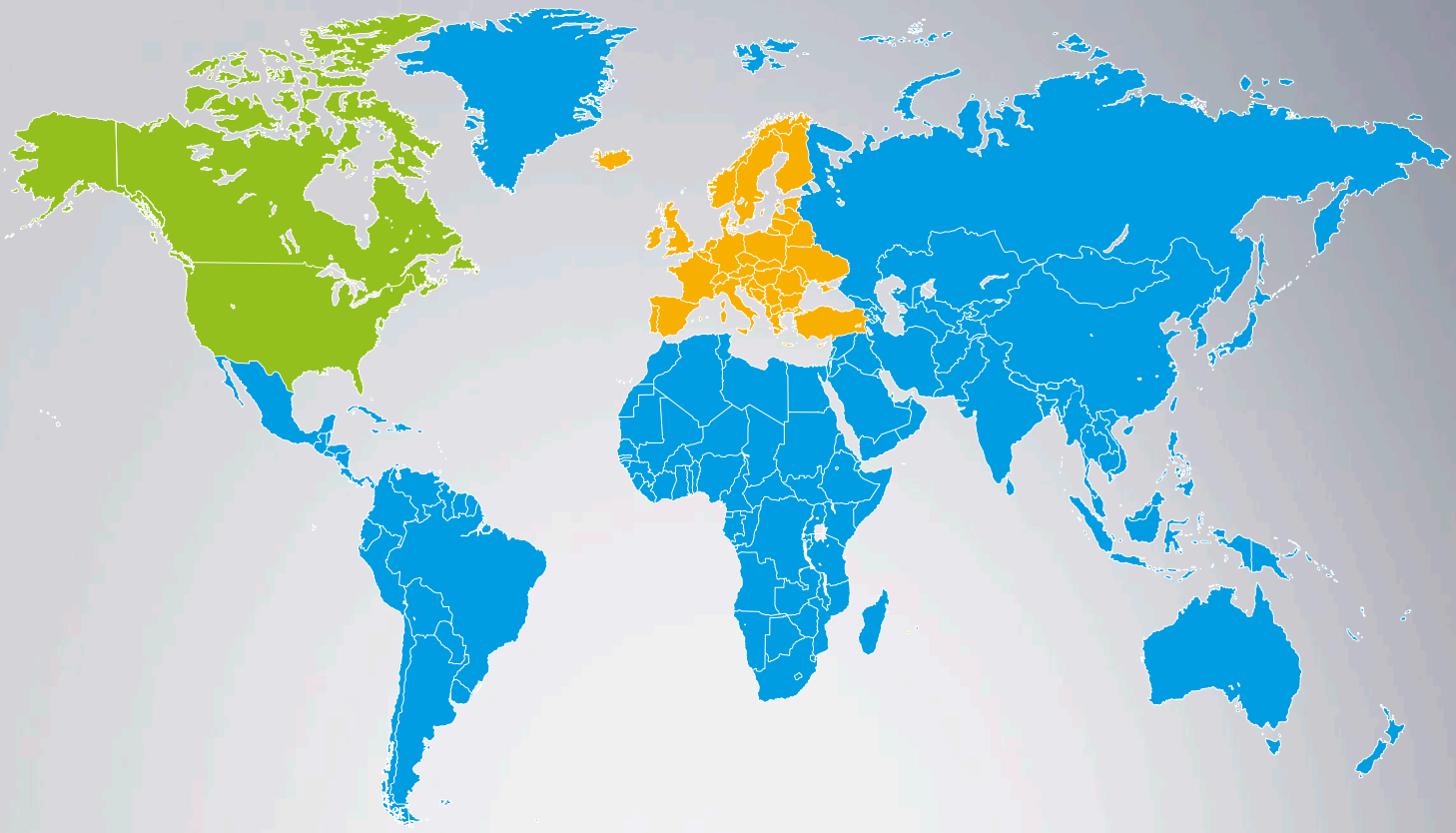
For all markets: approved as per ATEX, IECEx, NEC/CEC

For use worldwide: the explosion protection portfolio

For systems and equipment in areas exposed to explosion hazards, different standards apply all over the world:

- International explosion protection (IECEx)
- European explosion protection (ATEX)
- North American explosion protection (NEC/CEC)

Country-specific approvals such as IA for South Africa may also be required. Users must make sure that their installations meet applicable guidelines and standards. The Ex component portfolio from Beckhoff meets all listed standards and is certified for the intended use in hazardous areas in compliance with applicable regulations. As a result, PC-based control makes globally uniform solution concepts possible for barrier-free system integration up to Zone 0/20.



NEC/CEC	ATEX	IECEx
NEC certified	Ex	IEC IECEx
North America	Europe	International

Highly compact and intrinsically safe: EtherCAT Terminals for explosion protection

The ELX series: intrinsically safe according to IECEx, ATEX and NEC/CEC

With the ELX terminals Beckhoff combines highly compact remote I/O modules with isolating barriers for the direct connection of intrinsically safe field devices. The result: very slim EtherCAT Terminals for direct connection of intrinsically safe sensors and actuators. The high resolution and accuracy of the Beckhoff ELX terminals guarantee the same measuring quality that is familiar from the non-hazardous areas.. The compact design of the I/O terminals provides a further advantage: there are up to four intrinsically safe inputs available in the 12 mm housing and up to eight in the 24 mm housing. Dispensing with interconnected external barriers leads to a significant reduction in the space requirements inside the control cabinet and thus to cost advantages. With ATEX, IECEx and NEC/CEC certification, the ELX terminals comply with all industry-specific guidelines for explosion protection and can be used in nearly all markets worldwide, which reduces the user's dependence on different suppliers for different regions. The wide range of uses is also supported by the enormous variety of signals handled by the Beckhoff I/O range: there is a suitable I/O

module for every application. Using the ELX terminals, process technology users can realize extremely compact and economical control architectures where the outstanding diagnostic function of EtherCAT helps to minimize system downtimes.

The ELX terminals optimize virtually all process technology applications:

- Highly compact design of 12 mm housing width reduces space requirement by up to 50%.
- safety barrier and signal terminal combined
- direct connection of intrinsically safe field devices
- EtherCAT right up to the terminal
- wide variety of signals
- fulfils a comprehensive range of certificates
- considerable cost advantages

Analog input ELX3202/04	Analog input ELX3252	Analog input ELX3312/14	Analog input ELX3351	Analog output ELX4181	Encoder ELX5151	System ELX9012
2/4-channel	2-channel	2/4-channel	1-channel	1-channel	1-channel	Bus end cap
Resistance sensor (RTD)	Potentiometer	Thermo-couple/mV	Strain gauge	0/4…20 mA	NAMUR	
16 bit	16 bit	16 bit	24 bit	HART	32 bit	
				16 bit		

Twice as safe: the safety solution for explosion protection

ELX terminals for intrinsically safe signal transmission and functional safety
Beckhoff meets the increasing demands on process control technology with regard to functional safety by fully integrating safety technology into the automation system. The compact and modular design of the TwinSAFE safety solution integrates seamlessly into the control platform. Thanks to the fieldbus-neutral safety protocol (TwinSAFE/Safety-over-EtherCAT), the TwinSAFE devices can be integrated into any fieldbus system. These safety I/Os form the interfaces to the safety-relevant sensors and actuators.

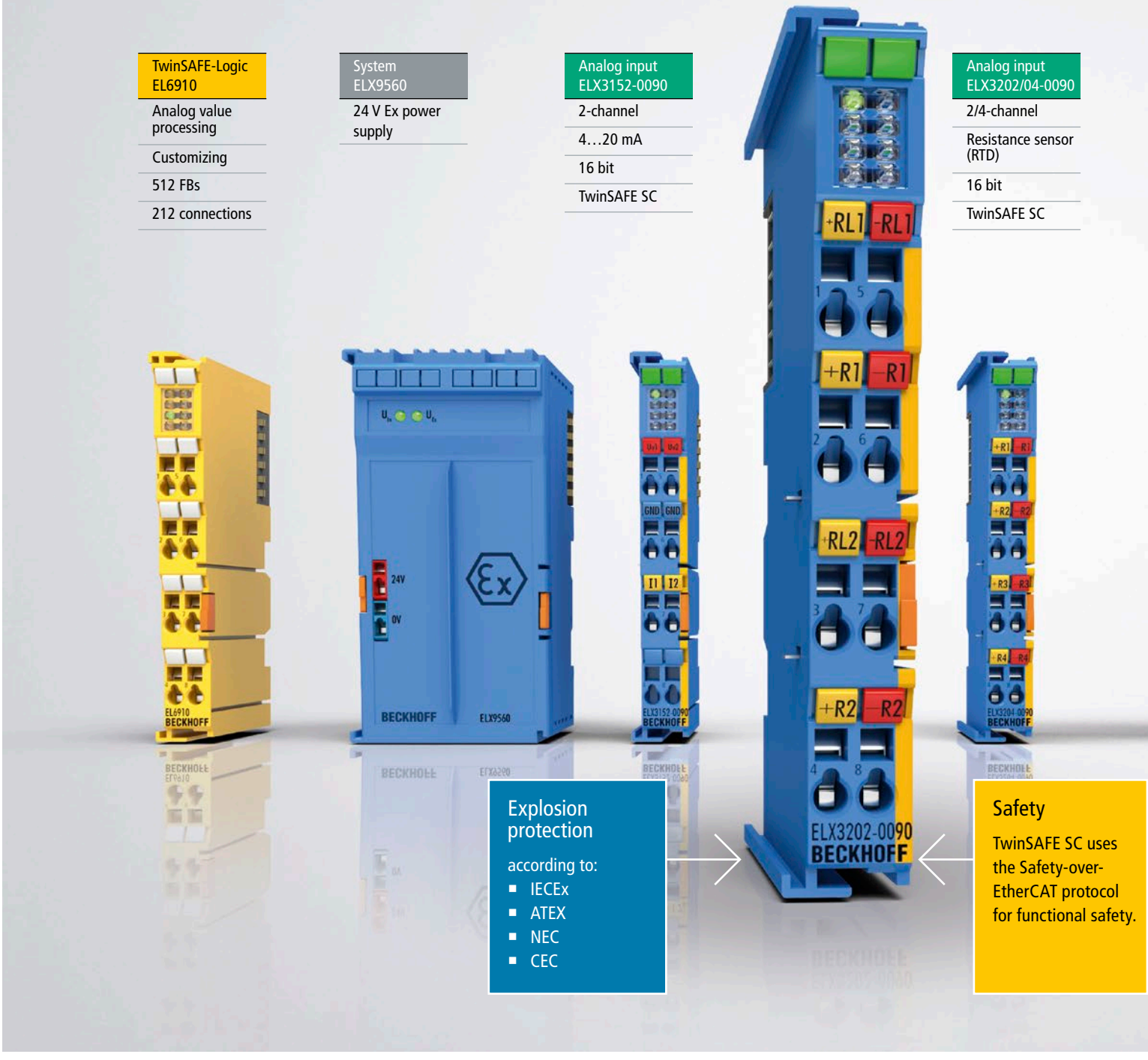
The TwinSAFE SC (TwinSAFE Single Channel) technology enables the use of standard signals for safety tasks in any networks of fieldbuses. The data of a TwinSAFE SC terminal are transferred to the TwinSAFE logic for secure processing in multiple channels. The data from various sources are analysed, plausibility-checked and subjected to "voting". Certified function blocks such as Scale, Compare/Voting (1oo2, 2oo3, 3oo5), Limit etc. are used for this purpose. For safety reasons, however, at least one of the data sources must be a TwinSAFE SC component. In this way, all process data available in the system can be made accessible to the safety technology.

TwinSAFE-Logic EL6910
Analog value processing
Customizing
512 FBs
212 connections

System ELX9560
24 V Ex power supply

Analog input ELX3152-0090
2-channel
4…20 mA
16 bit
TwinSAFE SC

Analog input ELX3202/04-0090
2/4-channel
Resistance sensor (RTD)
16 bit
TwinSAFE SC



Explosion protection
according to:
- IECEx
- ATEX
- NEC
- CEC

Safety
TwinSAFE SC uses the Safety-over-EtherCAT protocol for functional safety.

In combination with the ELX terminals, TwinSAFE SC technology offers a highly compact solution for applications with requirements for intrinsically safe signal transmission and functional safety. The ELX terminals extended with TwinSAFE SC enable direct connection of intrinsically safe field devices up to Zone 0/20, with safety levels up to PL d/Cat 3 according to EN ISO 13849-1 or SIL 2 according to EN 62061.

Functional safety and intrinsic safety in one system:

- highly compact solution with up to four channels across only 12 mm
- large analog signal diversity
- ELX terminals with TwinSAFE SC function enable direct connection of intrinsically safe field devices up to Zone 0/20
- safety level up to PL d/SIL 2 achievable
- considerable cost advantages

Analog input ELX3312-0090
2/4-channel
Thermo-couple/mV
16 bit
TwinSAFE SC

Analog input ELX3314-0090
2/4-channel
Thermo-couple/mV
16 bit
TwinSAFE SC

Analog input ELX3351-0090
1-channel
Strain gauge
24 bit
TwinSAFE SC

Encoder ELX5151-0090
1-channel
NAMUR
32 bit
TwinSAFE SC

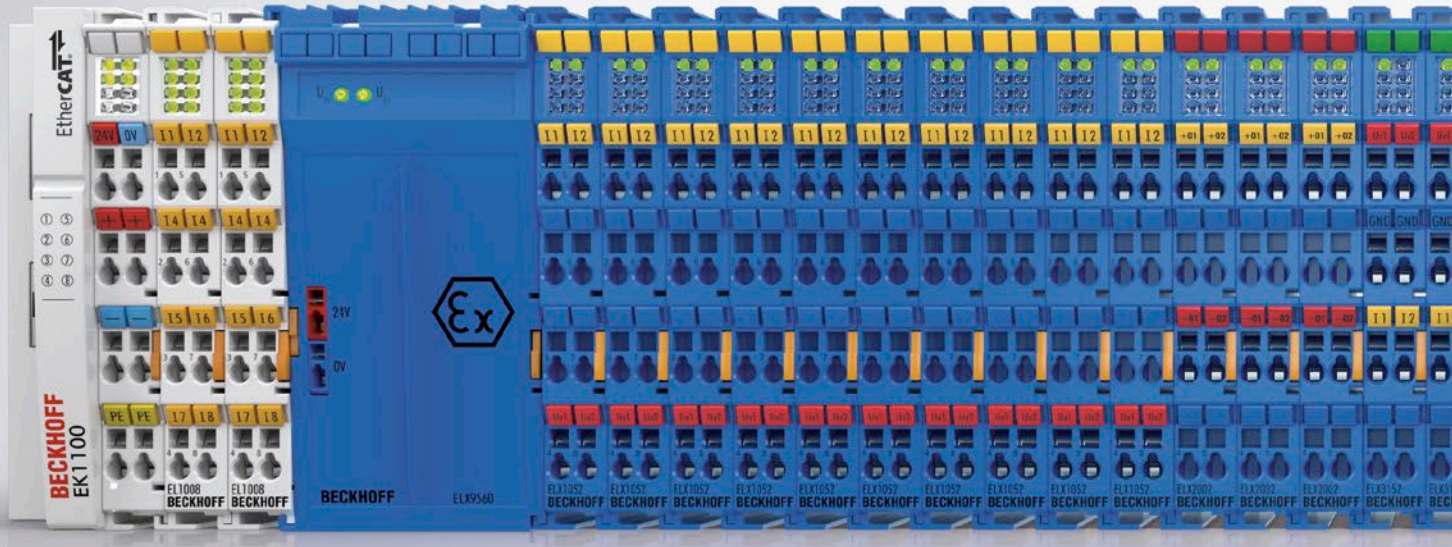
System ELX9012
Bus end cap

Full flexibility: the ELX system

Flexible configuration with E-bus refresh
The ELX system not only enables users to meet explosion protection requirements but also gives them complete freedom as far as the configuration is concerned. The flexibility and ability to combine the ELX terminals with the entire Beckhoff product portfolio makes it possible to build application-specific solutions that leverage the advantages of the terminals in terms of space efficiency and performance.

An ELX terminal segment begins with the ELX9560 power supply terminal, which ensures required distances to non-intrinsically safe circuits through its design and supplies the downstream ELX signal terminals via their power contacts. To the right of the ELX9560, any ELX signal terminals can be connected in sequence.

By combining the ELX9560 with the ELX9410 power supply terminal, it is possible to add more ELX terminals and extend the ELX terminal segment in order to make use of the total cabinet width. The frontal fin of the ELX9410 ensures that the minimum distance to the ELX terminals arranged to its left is maintained.



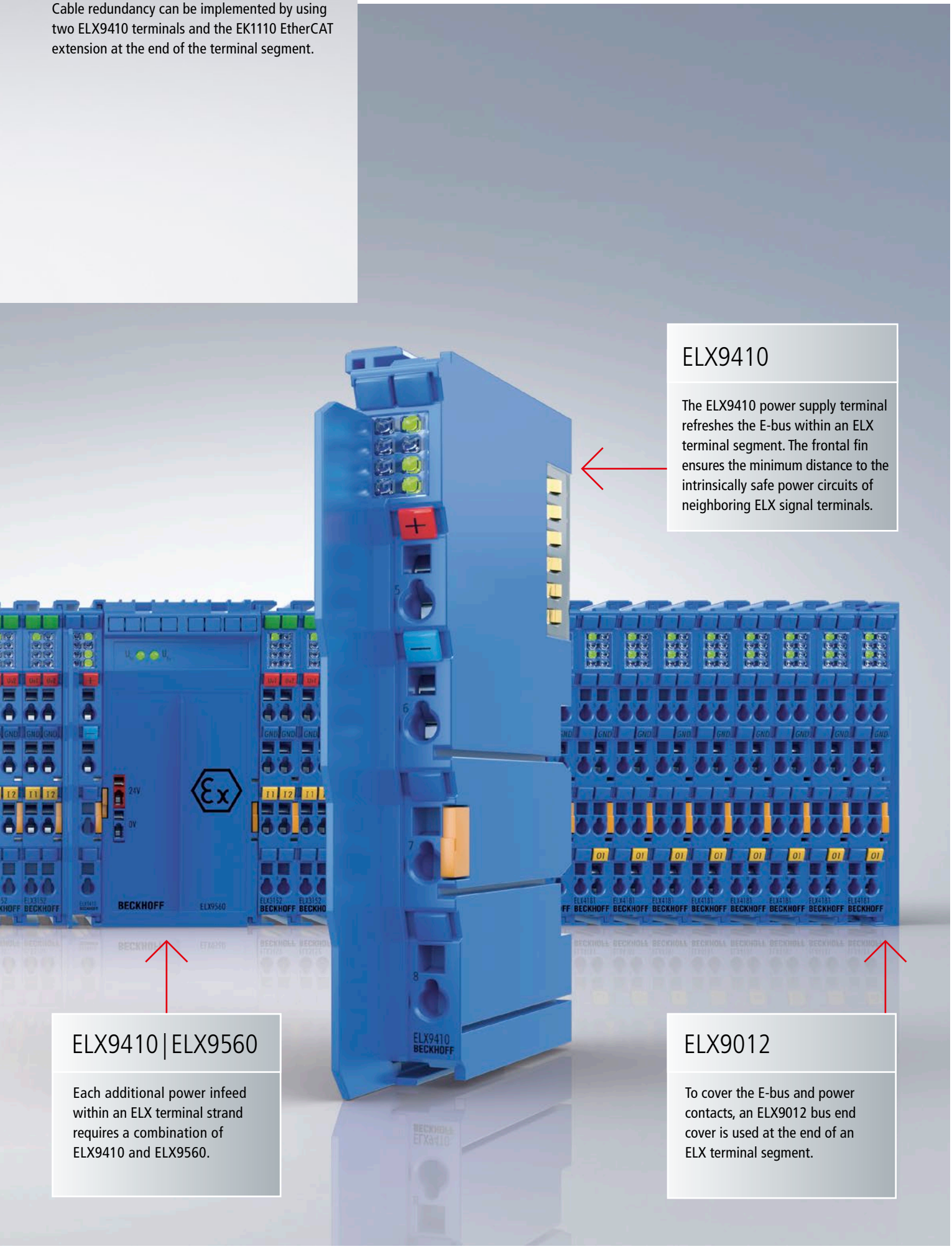
ELX9560

Each ELX terminal segment starts with the ELX9560 power supply terminal, which supplies subsequent ELX terminals via the power contacts.

ELXxxxx

ELX signal terminals feature high signal diversity and a compact design. The various modules can be freely combined according to individual application requirements.

Cable redundancy can be implemented by using two ELX9410 terminals and the EK1110 EtherCAT extension at the end of the terminal segment.



ELX9410

The ELX9410 power supply terminal refreshes the E-bus within an ELX terminal segment. The frontal fin ensures the minimum distance to the intrinsically safe power circuits of neighboring ELX signal terminals.

ELX9410|ELX9560

Each additional power infeed within an ELX terminal strand requires a combination of ELX9410 and ELX9560.

ELX9012

To cover the E-bus and power contacts, an ELX9012 bus end cover is used at the end of an ELX terminal segment.

Explosion-proof panel solution: the elegant CPX series in robust aluminium design

Control Panels and Panel PCs for multi-touch operating concepts in Zone 2
With the models from the CPX Panel series, the proven multi-touch technology of the Beckhoff Control Panel and Panel PCs is available in a particularly robust version and thus fulfils the requirements for use in in hazardous areas of Zone 2/22. The high functionality and high quality of workmanship ensure the durability of the CPX panel even under harsh environmental conditions. Local operation is comfortable as usual thanks to the capacitive touch technology. The appealingly aesthetic appearance of the Beckhoff Panel with regard to feel and design of the aluminium housing is virtually unchanged, making it a visual highlight in the explosion-proof system environment. The extensive CPX range includes a large selection of formats, sizes, mounting options and performance features. Depending on the area of application, panels for control cabinet installation and stand-alone panels for free mounting in the room are available in the CPX29xx and CPX39xx series. The fanless Panel PCs from the CPX27xx and CPX37xx series additionally offer a reliable system controller.

Robust:

All CPX models have a high-quality, resistant aluminium housing.

Intuitive:

All CPX models offer the advantages of the Beckhoff multi-touch technology.

Adaptable:

All CPX models impress with a wide variety of mounting concepts.

Multi-touch for process technology:

- capacitive touch technology for optimized operation
- high-grade design
- robust and durable
- large selection of Control Panels and Panel PCs
- flexible mounting
- Up to 100 m of distance between an explosion-proof panel and an Industrial PC can be bridged with CP-Link 4, which transmits video signals, USB 2.0 and power over a standard Cat7 cable.

Installation

CPX29xx/CPX27xx series



CPX29xx multi-touch built-in Control Panel:	**CPX2915-0000** 15-inch display 1024 x 768 resolution 4:3 format	**CPX2919-0000** 19-inch display 1280 x 1024 resolution 5:4 format	**CPX2921-0000** 21.5-inch display 1920 x 1080 resolution 16:9 format
CPX27xx multi-touch Panel PCs for control cabinet integration:	**CPX2715-0010** 15-inch display 1024 x 768 resolution 4:3 format Intel® Atom™	**CPX2719-0010** 19-inch display 1280 x 1024 resolution 5:4 format Intel® Atom™	**CPX2721-0010** 21.5-inch display 1920 x 1080 resolution 16:9 format Intel® Atom™

Stand-alone

CPX39xx/CPX37xx series



CPX39xx multi-touch Control Panels:	**CPX3915-0010** 15-inch display 1024 x 768 resolution 4:3 format	**CPX3919-0010** 19-inch display 1280 x 1024 resolution 5:4 format	**CPX3921-0010** 21.5-inch display 1920 x 1080 resolution 16:9 format
CPX37xx multi-touch Panel PCs:	**CPX3715-0010** 15-inch display 1024 x 768 resolution 4:3 format Intel® Atom™	**CPX3719-0010** 19-inch display 1280 x 1024 resolution 5:4 format Intel® Atom™	**CPX3721-0010** 21.5-inch display 1920 x 1080 resolution 16:9 format Intel® Atom™

Globally available: Beckhoff expertise for the process industry

New Automation Technology
Beckhoff implements open automation systems using PC-based control technology. The product portfolio comprises these main areas: Industrial PCs, I/O and fieldbus components, drive technology and automation software. Product lines are available for all areas and can be used as individual components or as a complete system. The New Automation Technology philosophy from Beckhoff represents innovative and open control and automation solutions that are used worldwide in a variety of applications ranging from CNC machine tools to intelligent building automation.

Worldwide presence on all continents
With local presence in 75 countries, Beckhoff ensures fast service worldwide and technical support in the local language for globally operating customers. In addition, Beckhoff sees close geographic proximity to customers as a prerequisite for a profound understanding of the technical challenges facing customers.

Beckhoff at a glance

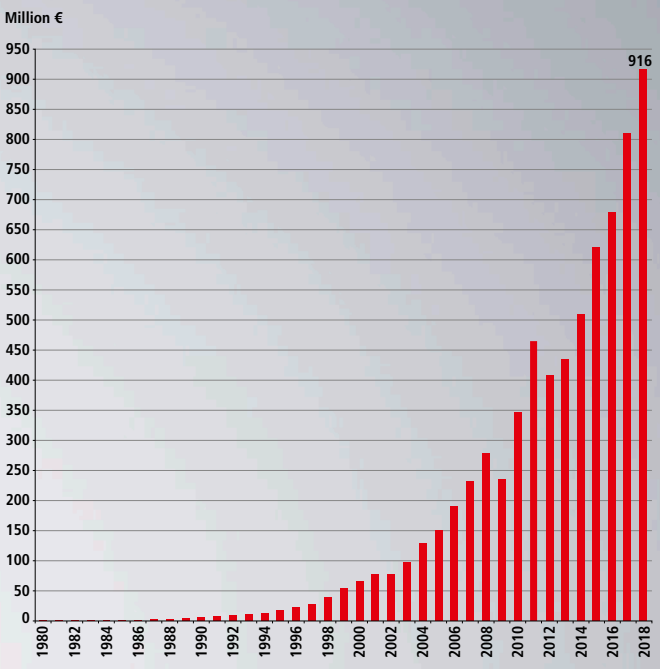
- headquarters: Verl, Germany
- 2018 sales: € 916 million (+13%)
- employees worldwide: 4300
- offices in Germany: 22
- subsidiaries/representative offices worldwide: 38
- distributors worldwide: in 75 countries

(as of 04/2019)

Further information

The Beckhoff catalogs and flyers are available for download on our website.

▶ **www.beckhoff.com/media**



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