

ctrlX
AUTOMATION



TWO STEPS AHEAD



A NEW WORLD OF AUTOMATION

The production world is changing and along with it the challenges it faces. Rigid, complex automation systems are no longer a right fit in a world where markets are characterized by ever shorter product life cycles and increasingly tougher competition.

The answer to the new challenges facing industry is: **ctrlX AUTOMATION.**

A new level of agility is needed to keep pace with the global speed of innovation. This is

precisely where Bosch Rexroth's vision of the "Factory of the Future" comes into play: only the walls, the floor and the ceiling of the factory will remain in place – everything else is flexible. The Factory of the Future dynamically reacts to demands and always offers the ideal solution.

This vision marks the beginning of a new world of automation with an automation platform that focuses systematically on the user. The developers have left no stone unturned in their quest to always find the best solution: an automation platform that is flexible and scalable through and through with maximum openness at all levels and interfaces.

ctrlX WORKS

The software and engineering toolbox

ctrlX WORKS is the central nervous system of the platform and reduces the engineering time for new concepts by 30 to 50%. In addition to classic PLC languages pursuant to IEC 61131, PLCopen, and G-Code, developers can implement functions without restriction in the form of apps or open source software. Individual functions can be installed and removed without any repercussions for existing apps and also tested virtually. The central ctrlX Data Layer guarantees continual access to all real-time and non-real time data of the installed apps. It is immaterial in this sense whether the apps are installed as runtime apps on a ctrlX CORE or are executed as engineering apps and services on a PC, smart device, or in the cloud.

ctrlX WORKS already includes an extensive portfolio of high-performance apps for typical tasks in the area of factory automation. In addition, users can develop their own programs in any programming language or integrate third-party apps.

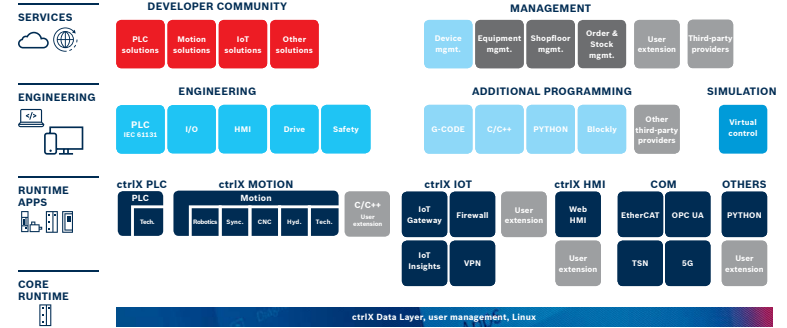
Highlights

More productivity

- ▶ Free choice of programming language
- ▶ Limitless functionality that can be implemented with ease
- ▶ Virtual testing without hardware
- ▶ Simple integration of own and third-party software

Less engineering

- ▶ Web-based engineering
- ▶ Pre-programmed functions and intuitive programming tools
- ▶ Developer communities and services



At a glance:

- ▶ Engineering is up to 50% faster
- ▶ Rapid adaptation to changes on the market

ctrlX PLC

The forward-looking PLC software

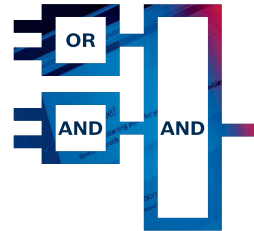
ctrlX PLC offers a high-performance PLC control solution and combines the advantages of classic PLC automation with the communication and functional requirements of the Internet of Things – a perfect combination for the Factory of the Future.

Modular principle for targeted application

The flexible use of ctrlX PLC guarantees that the ideal solution is always found for projects that demand high cost-efficiency, even in the case of distributed architectures. Ready-made function blocks and automatic code generation increase effectiveness and efficiency in engineering. In order to define motion sequences and target positions in drives, the corresponding function modules simply need to be called up and combined. Processes are simplified by wizard-controlled programming and the enhanced Generic Application Template with automatic PLC code generation. The open infrastructure enables protected integration of in-house know-how.

Open for networking

The ctrlX Data Layer provides all process and machine data centrally, replacing PLC line control systems. At field level, ctrlX PLC provides a master function for numerous fieldbuses such as EtherCAT, PROFINET, and EtherNet/IP. The data and information collected is forwarded on the basis of established standards such as OPC UA and MQTT. This means that ctrlX PLC can be integrated in the most varied automation environments.



Highlights

More productivity

- ▶ Openness and standards eliminate hardware dependencies
- ▶ Future orientation by design
- ▶ New degree of freedom with the ctrlX Data Layer
- ▶ Increased efficiency thanks to unrestricted choice of programming language

Fewer components

- ▶ Ultra-compact control platform with optimum performance and minimum variance
- ▶ Ultimate functionality and flexibility
- ▶ Savings on logistics, hardware, and assembly costs

Less engineering

- ▶ Know-how development through integration of own applications
- ▶ Free choice of programming language



At a glance:

- ▶ Highest performance, smallest hardware variance
- ▶ Reduced logistics costs
- ▶ Less time needed for familiarization and engineering
- ▶ The ctrlX Data Layer provides all process and machine data centrally, making PLC line control systems redundant



ctrlX IOT

The most modern IoT software

Industry 4.0, the industrial Internet of Things (IoT) or the Factory of the Future: The greatest productivity potential for industrial users lies in networking. That's why ctrlX IOT is always included as part of ctrlX AUTOMATION. Thanks to full integration of IoT solutions in the hardware, users have boundless possibilities and can start implementation straight away.

Ready to run in less than five minutes

Guided configuration dialogs are used to perform the configuration quickly and intuitively – without the need for programming. End users too can configure or change data connections quickly at the click of a mouse. With more than 30 direct connection options and communication standards, ctrlX IOT offers optimum flexibility for connecting different devices and integrating seamlessly into existing or also future systems. Non-reactive updates ensure an optimum level of machine availability during the production process, even when loading updates. A firewall and VPN access control all access continually in order to protect machine availability. IT security standards pursuant

to IEC 62443 provide enhanced protection against viruses and trojans. At the same time, the solution enables encrypted transmission of data and secure remote services.

Transparency unleashes optimum potential

Whether online or offline: Machine data can be transparently displayed retrospectively for up to six months with IoT Insights. This ranges from production KPIs to notifications for the shift manager to a fault history for service.

By integrating ctrlX IOT in the Nexeed industrial application system, a universal solution is created from sensor through to cloud applications. Among other features, Nexeed therefore enables central monitoring of machines through to global plant networks.

Highlights

More productivity

- ▶ Maximum production capacity and long-term availability thanks to non-reactive updates during the production process
- ▶ Local storage of machine data for maintenance
- ▶ Fully integrated IT security standards for access control and remote maintenance
- ▶ Seamless integration in the Bosch Nexeed industrial application system

Fewer components

- ▶ IPC and VPN router hardware is reduced to one control platform
- ▶ Cost savings and lower risk of failure thanks to hardware reduction and IT security standards
- ▶ Machine is "Bosch IoT ready"

Less engineering

- ▶ Optimum flexibility for integrating data in existing IT production systems with no programming
- ▶ Simplest handling for machine manufacturers and end users



At a glance:

- ▶ Increased system efficiency thanks to faster exchange of data with the IoT
- ▶ Full integration of automation components
- ▶ Cost savings through reduced engineering work for data connectivity

ctrlX MOTION

The motion, robotics, and CNC software

ctrlX MOTION sets new standards for openness and scalability. Users can perform the most varied automation tasks with this software: from simple handling tasks to complex robot applications through to highly dynamic machines, such as those used in the packaging and print industry. In this environment, they control multi-axis applications with strict requirements in respect of coordinated movements and synchronicity.

ctrlX MOTION forms the perfect basis for the intelligent automation of production machines. It implements both fast I/O signal processing and highly dynamic motion control tasks – with more than 100 axes per control system. ctrlX MOTION is executable on all ctrlX AUTOMATION hardware, adapts flexibly to the respective requirements and can be extended at any time.

ctrlX MOTION connects the previously separate worlds of automation and IT with the ctrlX Data Layer. Users can create functions as apps in any programming languages, even graphical ones, and combine them freely. This allows a previously unknown degree of freedom, flexibility, and efficiency.

Guided dialogs for visualization and engineering tasks optimize the project workflow in development and increase productivity through simple integration of innovative functions. Web-based engineering supports fast commissioning and shortens time to market.



Single Axis Motion



CNC



Synchronized Motion



Hydraulic Motion

Highlights

More productivity

- ▶ Shortest PLC and motion cycle times
- ▶ A control system coordinates more than 100 axes
- ▶ Ultimate precision thanks to axis synchronization at microsecond speed and with a nanometer level of precision

Fewer components

- ▶ All applications on one platform (synchronized motion, coordinated motion and hydraulic motion)
- ▶ Maximum scalability ensures the best possible solution in terms of space requirements and functionality

Less engineering

- ▶ The engineering time is reduced by up to 50% thanks to wizard-based development of application software and ultimate ease of programming
- ▶ Can be used for all applications



At a glance:

- ▶ Control system for universal and modern machine automation
- ▶ Cross-platform performance and openness
- ▶ Time-to-market is at least 30% faster
- ▶ Complete and open automation system



ctrlX CORE

The ultra-compact control platform

Nowadays mechanical engineering means software development. The high-performance and communication-ready ctrlX CORE forms the basis for this. It breaks down the boundaries between the IPC, embedded system, and drive-based platforms. The 64-bit multicore CPUs distribute the applications optimally to the different processor cores. They offer significantly higher computing power than previous control platforms in the same space. ctrlX CORE offers scalable control of single-axis movements through to highly complex multiple axis movements. It implements different technology functions with complex arithmetic operations in parallel with a high control quality and communicates with higher-level systems. Process data can be processed comprehensively by the control system when ctrlX I/O is activated. Optional I/O modules for additional functions and communication protocols in the same form factor simplify scaling.

Quality down to the tiniest screw

ctrlX CORE is expressly designed for demanding environments and withstands vibrations and impact in a wide temperature window with high EMC resistance. The hardware is designed for maximum maintenance-free operation and long-term availability based on a fanless and wear part-free design.

At the heart of open communication

Thanks to its open and flexible architecture, ctrlX CORE is ready to meet whatever the Factory of the Future may bring in the future. In addition to EtherCAT, the hardware supports many other common automation protocols. For example, the gigabit Ethernet interface is ideal for use in networked environments, supporting the data-intensive exchange of information with higher-level IT systems, HMI devices and cloud-based applications. The control system supports more than 30 IT and IoT standards, including OPC UA as server and client as well as the widely used MQTT protocol.

Highlights

More productivity

- ▶ Unlimited performance thanks to 64-bit multicore processors
- ▶ Optimum distribution of applications to the CPU cores

Fewer components

- ▶ Flexible extensibility with performance and I/O functions
- ▶ Robust hardware design

Less engineering

- ▶ One control system for all platforms



At a glance:

- ▶ Multicore technology for optimum performance
- ▶ The system that offers the best possible connectivity on the market
- ▶ Open and flexible architecture for new freedom in developing functions

ctrlX I/O

The powerful ctrlX CORE enhancement

With ctrlX I/O, Bosch Rexroth provides the ideal add-on for holistic automation solutions. This add-on connects the EtherCAT ecosystem to the machine control level.

Intuitive use at a new level

The compact I/O portfolio allows simple installation and cabling as well as rapid exchange of individual modules or extensions. Configuration is not required because automatic recognition integrates each module independently. Additional communication standards and interfaces can be integrated via the I/O Performance Line for enabling forward-looking concepts. Based on EtherCAT, ctrlX I/O supports real-time capable data processing. Simple configuration and commissioning shorten engineering times by up to 30%.

Enduring and diagnostic-friendly

ctrlX I/O is designed for use in industrial environments and fulfills the strictest requirements in terms of vibrations, temperature rating, and protection class. Clever diagnostic concepts, on-board sensor systems, or smart module diagnostics via NFC increase machine up-time and speed up diagnostics in the event of errors.



Highlights

More productivity

- ▶ Clever diagnostic concept at module and channel level reduces standstill times
- ▶ Robust design in IP20 protection class for maintenance- and fault-free operation in the control cabinet

Fewer components

- ▶ Up to 20 I/O points on 12 mm installation width
- ▶ Flexible extensibility with performance functions

Less engineering

- ▶ Tool-free assembly thanks to ergonomic mechanical design and PUSH-IN technology
- ▶ Supports the IO-Link standard for integrating intelligent sensors



At a glance:

- ▶ Extensible for holistic automation solutions
- ▶ Intuitive and ergonomic
- ▶ Simple installation and rapid exchange of modules
- ▶ Engineering times are reduced by up to 30%
- ▶ Strictest mechanical requirements
- ▶ Real-time-enabled data processing



ctrlX IPC

The PC-based automation solution

Sophisticated process control systems often require high performance reserves, which ctrlX IPC provides flexibly and scalably. Thanks to low power loss, the hardware design needs neither a cooling concept nor fans, thus facilitating a long and fault-free operating time. The modular ctrlX CORE control platform can be integrated in the open ctrlX IPC portfolio via the PCIe interface. This means that the system can be extended by standard components or open source software. Numerous interfaces are available for communication. ctrlX IPC forms the ideal interface between field level and cloud and ensures reliable and secure transmission of large quantities of data.

Security intelligence for large volumes of data

The integrated hardware and software security infrastructure safeguards the application and machine availability at the same time. The hardware robustly withstands impact and vibrations and offers high EMC stability. It is therefore ideal for use in practically any application and environment. The use of high-performance and robust SSD memories from upwards of 64 GB allows future-proof machine designs and offers reliable protection against data loss in the RAID system. All IPCs contain data backup and recovery software as standard on delivery.

Trusted platform modules (TPM 2.0) use encryption software to protect the computer right through from booting until the application is running (security by design). This chip also stores certificates and serves as a hardware key for further protection mechanisms. Windows 10 IoT Enterprise LTSC (Long-Term Servicing Channel) as the operating system is a key component of ctrlX IPC; it was developed specially by Microsoft for networking intelligent devices on the most varied platforms. Linux can likewise be used as the operating system.

Highlights

More productivity

- ▶ Scalable performance from entry-level through to high-end applications
- ▶ The latest hardware with security-by-design integrated TPM chip
- ▶ High long-term availability thanks to maintenance-free hardware without batteries and fans

Fewer components

- ▶ Integration of the ctrlX CORE industrial control platform
- ▶ Space-saving design with low installation depth

Less engineering

- ▶ Maximum flexibility and modularity
- ▶ Flexible topologies
- ▶ High performance and openness with Windows 10 IoT or Linux
- ▶ ctrlX IPC components are designed strategically for one-person installation



At a glance:

- ▶ Scalable IPC portfolio from entry-level solution to high-end application
- ▶ Maximum flexibility across all performance ranges

ctrlX HMI

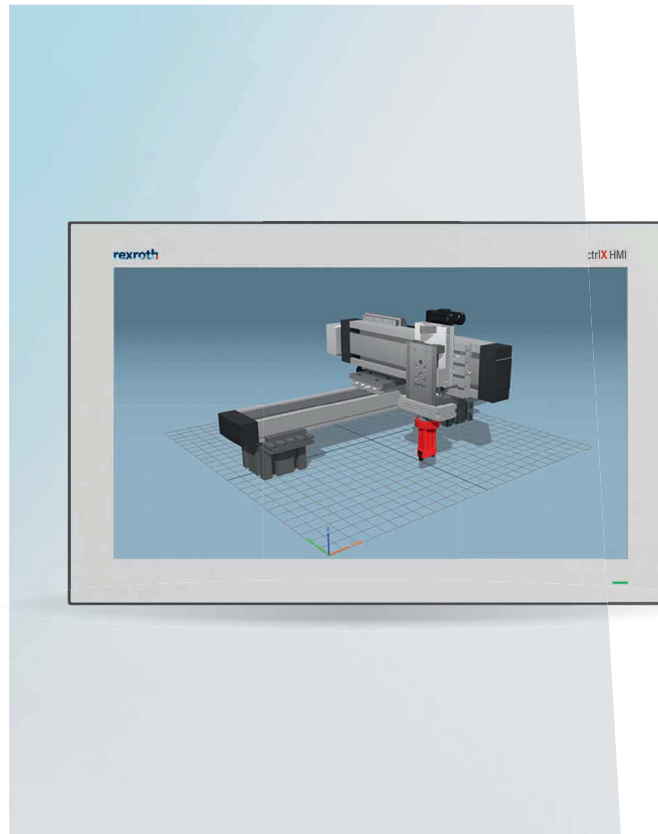
The perfect user experience combination

The right information at the right time: ease of use is an increasingly important factor when deciding to purchase a machine. ctrlX HMI offers machine manufacturers optimum freedom when it comes to implementing the user experience with intuitive user guidance.

Innovative and mobile HMI solution

The portfolio includes small operating panels, tablets, panel PCs, or large stationary displays with a screen diagonal of up to 24". Anti-glare and chemically hardened front glass make display and operating panels ideal for use in harsh everyday production environments. The 16:9 screen size supports multi-touch operation with ten fingers.

The web-based software solution ctrlX HMI adapts every representation automatically to different display sizes and prepares important information clearly at all times. Third-party provider tools can be used additionally, which communicate via standard interfaces such as OPC UA. ctrlX HMI covers all applications reliably – from the simplest process controls through to demanding and dynamic simulations.



Highlights

More productivity

- ▶ Scalable portfolio from small operating panels through to 24" displays

Fewer components

- ▶ Web-based HMI with integrated web server

Less engineering

- ▶ Integrated web-based HMI engineering and simple integration of third-party provider HMI tools
- ▶ Integration of 10" smart devices for the mobile HMI solution



At a glance:

- ▶ Perfectly harmonized hardware and software for intuitive visualization
- ▶ Robust hardware
- ▶ Long life cycle

ctrlX DRIVE

The most compact drive system

Bosch Rexroth has developed the most compact modular drive system in the world for its customers with ctrlX DRIVE. Apart from space-saving dimensions and maximum scalability, ctrlX DRIVE boasts advantages such as virtually unlimited combination options for users, sophisticated engineering tools, and high energy efficiency.

Flexible supplier concept

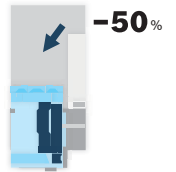
The new drive generation offers both simple single-axis applications and complex multi-axis machine systems. The scalable drive portfolio includes converters, single and dual-axis inverters, DC/DC converters, and power and regenerative supply units. ctrlX DRIVE therefore offers tailored solutions with peak currents of 6A to 375A. Sufficient power is always available even for extensive machine designs with output of up to 260kW.

Space requirements are halved

The powerful ctrlX CORE control hardware can be integrated in the drive housing without needing additional space. Overall users save up to 50% in the control cabinet. Further space savings are possible in combination with the modern MS2N motors, since they offer a power density that is up to 30% higher.

Complete performance package

All components in the ctrlX DRIVE system can be combined freely with one another. Users can extend the drives with additional hardware and software functions with the ctrlX DRIVE^{plus} option. Add-on boards for additional encoders, I/O extensions, and the integrated ctrlX CORE control system offer previously unattainable degrees of freedom.



Secure and energy-efficient

With a reaction time of around 4ms, ctrlX DRIVE offers one of the fastest SafeMotion solutions on the market. The energy management functions enable energy to be exchanged in the link connection and central network access components. The patented Smart Energy Mode reduces peak power of the drives by up to 70%. The converters can be used at the same time as supply units and inverters. In addition, classic power and regenerative supply units are also available. The continuous DC bus optimizes the power requirement and reduces power loss.



At a glance:

- ▶ Most consistent drive system on the market
- ▶ Space savings of up to 50%
 - ▶ Cost-efficient entry-level solution through to high-end solution with integrated motion control



Robust design

ctrlX DRIVE has a robust EMC design. The new power connector with integrated grounding concept allows even better interference resistance. The integrated DC bus connection eliminates accessory sets and is designed for high ampacity (up to 375 A).

Highlights

More productivity

- ▶ Peak currents of 6A to 375A
- ▶ Converters, power and regenerative supply units with peak power of up to 260 kW
- ▶ Flexible power supplier concept – space saving, flexible, and energy-efficient

Fewer components

- ▶ Up to 50% less space is required in the control cabinet
- ▶ Perfect for 300mm control cabinets owing to modular multi-axis concept
- ▶ Integrating ctrlX CORE eliminates the space required for the control system fully

Less engineering

- ▶ Intelligent functions such as multi-Ethernet, multi-encoders, integrated web servers allow simple diagnostics
- ▶ Less wiring and faster engineering
- ▶ Single-cable technology

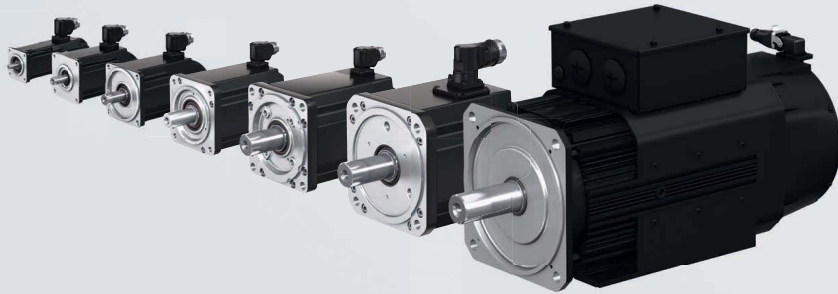
The high-performance servo motors

Bosch Rexroth servo motors are the perfect team player in the ctrlX DRIVE portfolio. Boasting compact dimensions, they combine optimum dynamics with maximum precision of position, speed, and torque values.

Motors for every requirement

The broad model portfolio includes the right solutions to meet all requirements. An ATEX-compliant series is therefore available

for environments with explosive gases and dust. The rotary and linear direct drives in the MS2N motors dispense with mechanical transmission components like coupling and gears. The innovative single-cable technology with cable length of up to 75 m reduces the cabling effort by 50%.



Engineering for experts

Developers have access to the digital twin of the motor, which is stored in a design tool and in the ctrlX DRIVE controller. Planning and design of even complex drive systems can therefore be virtualized quickly and reliably. A new torque model transforms each motor into a data source for intelligent machines or Industry 4.0 applications.



Highlights

More productivity

- ▶ High torque density for greater power
- ▶ 7 frame sizes with maximum torque of up to 692 Nm
- ▶ Maximum dynamics of the servo axes due to low motor inertia and high overload capacity

Fewer components

- ▶ Robust single-cable connection with a cable length of up to 75 m
- ▶ MS2N with integrated SafeMotion encoder – no further safety components are required
- ▶ Motor as torque sensor makes external sensors redundant

Less engineering

- ▶ Plug-and-play expanded encoder data memory for faster commissioning
- ▶ Digital twin of the thermal motor model



ctrlX SAFETY

The most comprehensive SafeMotion and SafeLogic solution

Safety first: standardized safety is an absolute prerequisite for machine manufacturers and users. ctrlX SAFETY simplifies implementation of standardized safety while ensuring maximum productivity during usage.

Certified safety as standard

The new ctrlX DRIVE drive generation is fitted systematically with extensible safety functions. SafeMotion implements safety functions precisely where motion occurs and responds within 4 ms. Of particular interest for modular concepts is that manufacturers can use SafeMotion to implement a purely drive-based safety solution in their assemblies, which operates independently of the higher-level control system.

SafeLogic safety control is an optional and compact extension of the standard control system. Graphical programming simplifies engineering and reduces the familiarization time.

SafeMotion and SafeLogic as a package solution

SafeMotion and SafeLogic together communicate via Bosch Rexroth's own safety bus at a speed that is 10 to 15 times faster than via classic fieldbuses. Safety equipment can therefore be designed more compactly thanks to the fast reaction times.

ctrlX SAFETY covers the full range from entry-level solutions to highly complex applications with different packages. Once they have been created, safety solutions can be integrated into different machine designs without any major adaptations. ctrlX SAFETY simplifies engineering in the process too through dialog-based acceptance tests. Intelligent software modules simplify parameterization in this context. The unrestricted choice of bus systems ensures perfect communication between components.

Highlights

More productivity

- Fastest safety solution on the market with reaction times of 4 ms
- Optimum integration into machine concepts

Fewer components

- Less hardware thanks to software-based scaling
- Space savings owing to faster reaction times by the system

Less engineering

- Simplified creation of application programs through graphical programming of the safety logic and dialog-based support for the acceptance test



At a glance:

- Fast and adaptable, can be used individually or as an overall system
- The reaction time of the safety solutions enables a more compact design
- Maximum safety in production



ctrlX Configurator

The intuitive tool for a systemic automation solution

The ctrlX Configurator supports the complete ctrlX AUTOMATION portfolio and enables individual configuration of automation solutions – simply, quickly, and reliably. Users create the desired system topologies graphically without product knowledge. Support or the offer can be queried directly from the configuration. Round the clock – worldwide.

- ▶ Graphical configuration of components and complete automation solutions
- ▶ Intuitive handling via modern operating concept with dynamic 3D product view
- ▶ Individual problem-solving without product know-how with manufacturer-independent product library
- ▶ Faster configuration via solution templates and 24/7 availability of the online platform
- ▶ System-wide consistency of the solution configuration through automatic verification of product relationships
- ▶ Support for processing in project teams and for support and availability queries

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