Automation Studio 4
Integrated automation
Contents

Automation Studio 4 ........................................................................................................ 04
Results, FAST! .................................................................................................................. 06
Integrated software engineering ...................................................................................... 08
Open at every level ........................................................................................................... 10

Software engineering with Automation Studio ................................................................. 12
Mechatronic synergy through concurrent engineering .................................................. 14
Sustainable software ......................................................................................................... 16
Drag & Drop – Hardware configuration has never been so easy ...................................... 18
Combine programming languages as needed .................................................................. 20
Integrated HMI package ................................................................................................. 21
One tool for universal motion control ............................................................................. 22
Virtual wiring – Real safety .............................................................................................. 23
Lock in your software investment .................................................................................... 24
Series-produced machine manufacturing with software on demand ............................. 26
Integrated online diagnostics ........................................................................................ 28
Maximum availability through redundancy .................................................................... 30
The APROL process control system .............................................................................. 31
Inside Automation Studio 4 – Core features .................................................................. 32

For every industry ............................................................................................................ 35
POWERLINK – The standard for real-time Ethernet ....................................................... 36
openSAFETY – The only fieldbus-independent safety protocol ...................................... 37
Optimize your system ...................................................................................................... 38
Automation Studio 4

→ **One tool**
  A single uniform programming tool for every aspect of an automation project minimizes training needs, solidifies overall integration and eliminates communication problems between engineering disciplines.

→ **Reduce lead times**
  Accelerate time to market with automatic code generation from machine simulations, utilization of configuration data from electrical engineering software and efficient collaboration supported by breaking down software development tasks into modules.

→ **Cut development costs**
  Save time and money by starting software development before the hardware is completed, reusing software modules across multiple projects, validating functionality via simulation and carrying out commissioning module-by-module.

→ **Improve reusability**
  System-supported, fully graphical hardware configurations and software modularization at every level facilitate the development of machines and systems that take advantage of pre-programmed technology components.
Results, FAST!

Automation Studio 4 is the ultimate tool for the field of machine and systems engineering. Through its sustainable and efficient approach to software development, it will help you keep your quality up, your engineering costs down and your time-to-market short – even in the face of ever-increasing product complexity.

The capital goods market expects continuously expanding functionality while keeping prices constant. It demands top quality, a long useful life and low operating and service costs. The only way for machines and systems to meet these requirements and offer real added value to the bottom line is through increased complexity. Increasing the time spent planning, developing and building these products is not an option since fierce competition is driving companies to gain a technological edge.

A paradigm shift towards success
Parallel engineering is one of the keys to accelerated development. This means starting software development as soon as the specifications are defined, simultaneously and hand-in-hand with the development of the mechanical and electrical components. It also means having multiple programmers working concurrently on various aspects of the overall software solution.

Another key to achieving ambitious development goals is reusing existing software elements that have already proven themselves in the field – whether modules developed in-house or pre-programmed technology components. This saves the time and effort that would otherwise be spent on programming, testing and certification.

As a single tool for machine and system automation, Automation Studio 4 delivers an unprecedented array of cutting-edge features to support every stage and aspect of product development. It empowers software developers to master the growing complexity of mechatronic systems – quickly, efficiently and without compromising quality.
Faster to learn
- Intuitive user guidance
- Consistent user interface for all aspects of an automation project
- Ready to use immediately

Faster to program
- Versatile programming in IEC 61131-3, C, C++ and CFC languages
- Scalable hardware platform with long-term availability
- Open standards and bidirectional interfaces

Faster service
- A single partner for control, HMI, motion and safety technology
- Comprehensive remote diagnostics
- Worldwide support
Integrated software engineering

Automation Studio 4 is the one development and runtime environment for every aspect of an automation solution – from control and motion technology to HMI, operation and integrated safety technology. The 4th generation of this powerful software engineering platform for industrial automation has been completely redesigned to help users work more efficiently and effectively.

Today’s software developers are confronted with an unprecedented diversity of hardware options, both on the machine and on their desks. To keep up with the mounting complexity, functional density and variety of tasks involved in each machine, development methods have been forced to evolve dramatically.

Time-to-market goals can no longer be achieved by waiting until the machine is built and the hardware is in place before rushing through software development under extreme time pressure. While today’s programming tools are indeed able to accelerate the task of programming itself, the greatest potential for efficient and sustainable product development lies in merging the fields of mechanical, electrical and software engineering and treating machines and systems like the integrated creatures they really are.
The advantages of object-oriented programming

The behavior of a machine or system is governed by its software. It is the software that steers every process and movement, it is the software that manages vital messages and operating data, and it is the software that ensures appropriate responses to user input, instructions from external systems and events reported to it via sensors.

Software development can therefore begin on the basis of the same specifications as the mechanical design, even when many details of the mechanical design are likely to change. The advantages offered by object-oriented programming can be leveraged to create structures and variables that can be filled in with actual values at a later stage.

Bidirectional data exchange with CAD systems

Automatic code generation from simulation models helps align the software with the mechanical design very early in the development process. Programming is further reduced by being able to create individual components or entire modules in advanced CAD software using data generated from simulating kinematic and dynamic systems. When it comes to electrical planning as well, there are many benefits to avoiding the unnecessary effort and risk of errors associated with having two versions of the master data. Now, software developers can easily synchronize ECAD projects with the hardware configuration in Automation Studio using the EPLAN Electric P8 interface. This bidirectional exchange ensures that both sets of data are always up to date.

Sustainable savings through reusable modules

Integrated tools facilitate teamwork, while automated version management reduces the time spent on coordination and documentation. Helpful features such as automatic generation of master data, a visual hardware configuration tool and convenient object-oriented programming make designing software even more enjoyable.

Self-contained modules that exchange data via clearly defined interfaces instead of accessing global variables can be arranged into any conceivable hierarchy. Automation Studio makes it easy to divide an overall application into subprojects for multiple developers or to outsource individual software components. It grants you the agility to successively upgrade complex machines component-by-component without the hassle of having to completely reprogram them. A modular software architecture makes it easy to leverage the full potential of technology components and function libraries. Not only does this mean fewer hours spent writing and testing code, it also allows you to create dynamically configurable machine variants and optional features.
The only future-proof solution is an open solution. Openness allows you to work with the tools you are most comfortable using. It allows machines to communicate effortlessly with external systems. And by facilitating the reuse of existing software for future solutions, it frees up valuable time to get your product to market faster. Proprietary solutions, step aside. The future is Automation Studio 4.

Automation Studio 4 allows PLC programming in all IEC 61131-3 languages, in CFC and C, as well as object-oriented programming in C++. This not only allows programmers to work in their preferred language, it also means existing code can be integrated with no added effort. The availability of PLCopen function blocks such as those for motion control and safety further simplifies programming, as do connectors for integrating code generated automatically from simulation tools.

Project files are shared exclusively in XML format, the de facto IT standard, which ensures open communication with third-party systems such as material management and production planning.
software. Further support is provided by direct access to databases via the SQL interface.

**Many interfaces to other systems**

Automation Studio 4 utilizes OPC Unified Architecture, or OPC UA for short, for its direct connection to the plant management level. This protocol provides convenient functions that make developers’ lives easier, and as a young market standard with an open architecture, it promises long-term compatibility with an extremely wide range of third-party systems. Automation Studio 4 also supports various Internet technologies through the use of dedicated libraries that streamline the implementation of location-independent approaches to operation and production.

With options for the direct integration of all fieldbus systems, Automation Studio 4 opens up the full spectrum of available field devices and provides optimal support for third-party system integration. Integrated safety solutions – also programmed in Automation Studio 4 – are also completely independent of the fieldbus system being used.
Software engineering with Automation Studio

01 Communication
- All devices networked to form a complete, synchronous system via POWERLINK
- Simple, controlled access to machine data with OPC
- Seamless integration of fieldbus devices
- External databases linked directly to the machine

02 Project management
- Investment protection through software reusability
- Complete integration of all B&R products yet also open to those from other manufacturers
- Source control system for assured access to defined development versions

03 Programming
- Compatibility with IEC 61131-3 languages, CFC and ANSI C
- Object-oriented programming in C++
- Extensive technology libraries
- Integration of code from third-party applications
- Access to all PLCopen function blocks

04 Diagnostics & Remote maintenance
- Comprehensive and integrated diagnostic functions
- Graphical analysis of machine states
- Web-based diagnostics with the System Diagnostics Manager

05 Drives & Motion control
- Uniform programming – from stepper motors to servo drives
- Easy access with standardized PLCopen integration
- Comprehensive support from configuration to commissioning
- One homogeneous system from single-axis solutions to CNC and robotics applications

06 Safety
- Uniform view of safe I/O data in the standard and safe application
- No impact of functional changes on the safe application
- Safety during programming through the use of certified PLCopen function blocks
- Fieldbus-independent safety technology with openSAFETY

07 Operation & Monitoring
- Integrated machine visualization – from small displays to entire SCADA packages
- Machine visualization on the controller – local, remote or virtual
- Multilingual applications using Unicode

08 Control
- Complete integration of control, HMI, motion and safety technology
- Software compatibility across all hardware platforms
- Dynamic updating of plant components
- Decentralized hardware, local data management
With Automation Studio, developers can program, test and optimize open and closed control loops and algorithms, movement sequences and visualization interfaces - all in a single development environment. This eliminates the problems that arise when interfacing between separate tools and significantly increases development efficiency. Through the use of open communication and software architectures and the application of modern, sustainable development techniques, this integrated development platform and real-time operating system supports time-saving development of high-quality complete solutions from start to finish. Eliminate barriers between systems and tap into the full potential of reusable software components with Automation Studio 4.
Mechatronic synergy through concurrent engineering

When manufacturing machines and systems, the disciplines of mechanical, electrical, control and software engineering come together to produce fully integrated mechatronic systems. While the complexity of these systems continues to grow, the amount of time permitted for developing them is shrinking. With the array of powerful features and intelligent links to third-party systems provided in Automation Studio 4, developers are perfectly equipped to benefit from the synergy of mechatronic engineering. Achieve series production readiness directly at the prototype stage – faster, cheaper and with uncompromising quality.

A mechatronic system merges mechanics, hydraulics and pneumatics with electrical equipment, control technology and software. In times of tight market entry windows, tighter budgets and increasing demands on complexity and efficiency, development of machines and systems must be both fast and cost-efficient. Ruling out risks that could lead to missed development targets is essential. The key to shortening the overall development cycle is to start work in all of these different disciplines simultaneously. Since the software is responsible for the behavior of the machine or system, including all processes and movements,
its development can begin at the same time and based on the same specifications as the mechanical design.

**Accelerated development through simulation**

Simulation-based engineering using computer models of the features under development helps align the software with the mechanical design very early in the development process. These models are generated based on data from the simulated kinematic and dynamic behavior of individual components or entire modules in the CAD systems used by the mechanical engineers.

**Automatic code generation**

The ability of simulation tools like MATLAB/Simulink and MapleSim to analyze simulated processes and convert them into source code in C or Structured Text greatly simplifies and expedites software development. Instead of programming everything manually, you can simply import this code directly into Automation Studio and use it as a self-contained application module in the control software. This saves valuable development resources and eliminates a potential source of mistakes and misunderstandings. Symbolic algorithms developed by B&R optimize and accelerate code execution without reducing the effectiveness of the model.

**Higher quality with no additional effort**

The code for physical simulation models is generated automatically and transferred to the B&R automation hardware, where it can be used to test the machine’s behavior using hardware-in-the-loop (HIL) simulation. Any necessary adjustments identified through this simulation can be made conveniently right in the simulation model.

Conversely, function blocks can also be sent from Automation Studio 4 to Simulink or MapleSim and tested there. This accelerates software development processes in several ways, for instance by integrating quality assurance verification with no added effort. ARsim, the runtime environment simulator integrated in Automation Studio, allows you to simulate operation of a controller without any hardware. But the options for virtual testing and commissioning don’t end there. You can also simulate any of the drive systems from B&R’s ACOPOS series, including the loads to be moved by the connected motors. Or you can use a 3D hardware model to simulate the real-time behavior of inputs and outputs in conjunction with the planned hardware.

**Multidisciplinary concurrent engineering**

By removing the barriers between engineering disciplines, Automation Studio 4 helps you optimize the development workflow and further accelerate your time-to-market. A bidirectional interface with the database system of the leading ECAD tool, EPLAN Electric P8, helps synchronize your electrical and hardware configurations to avoid redundant or inconsistent data entry. Support for EPLAN’s database platform is also provided by other tools commonly used in the field of machine and systems engineering, which means it is just as easy to integrate MCAD designs and plans for hydraulic and pneumatic components.

Automation Studio 4 allows you to import entire hardware topologies directly from EPLAN Electric P8, including corresponding I/O mapping data and process variables, and align them bidirectionally.

**Highlights**

- Shortened lead times by starting software engineering earlier
- Improved products through concurrent engineering
- Guaranteed results using simulation
- Accelerated development cycles
- Enhanced software quality
The ability to break software development into separate tasks that can be completed in parallel by multiple developers or teams saves an incredible amount of time. These time savings are increased even more by being able to store frequently used functions in software modules that can be reused whenever needed. Through its commitment to intelligent software modularization, Automation Studio 4 helps you reach your development goals quickly while maintaining quality throughout every aspect of your project.

In order to respond to the increasing complexity of today’s products without throwing schedules and budgets to the wind, mechanical designers have discovered the advantages of standardization and modularization. They develop standard parts and components to perform specific functions and combine them as needed into a complete machine or system using well-defined connections. In many design offices, projects are split up between specialists in the various engineering disciplines.

Mastering product complexity
The modularization approach has been fully embraced by mechanical engineers and has been a mainstay in the IT world for years. To continue using obsolete methods reminiscent of the earliest days of PLC programming would make developing software for today’s complex mechatronic systems an unnecessarily grueling endeavor.
As the operations performed inside machines and systems become increasingly complex – and more simultaneous – there is a blurring of lines between programmable logic, CNC, robotics, intelligent axis control, HMI and communication. If a software solution is going to rise to the challenge of increasing complexity to manage entire machines and intricate algorithms without becoming unwieldy or inefficient, a modular structure is absolutely essential. In the same way that mechanical engineers use standard parts and components, a modular software structure is created using libraries of standalone functions, processes and control algorithms.

Automation Studio 4 supports modular programming using self-contained application modules. An application module can represent a single function, a machine component or an entire machine module. Internally, they contain a hierarchy of function blocks, entire programs or various combinations of the two.

**Divide and conquer**
Assembling larger programs from multiple application modules considerably simplifies program navigation and maintenance. In addition to providing a more intuitive representation of a modular machine design, modular software also naturally facilitates the division of tasks across multiple developers, who can develop and thoroughly test their modules independently of one another. This approach offers the freedom and security to use an external service provider or even let the customer program certain parts of the solution if needed.

**Successive upgrades to functional components**
Rather than develop each new generation of a machine in its cumbersome entirety, manufacturers can take the much more responsive and efficient approach of successively upgrading each of its functional components. A more balanced workload allows development teams to operate more efficiently, with the resulting boost in quality paying off immediately through shorter commissioning times.

### Highlights

- Improved quality through defined interfaces
- Reduced risk of errors due to more manageable workload
- Faster development through parallel engineering
- Intuitive development of modular machine designs
- Simple and secure integration of third-party solutions
The System Designer feature in Automation Studio 4 helps lay out your hardware quickly and accurately by letting you arrange devices and connections in a realistic control cabinet view and making it easy to configure common components once and reuse them again and again. It contributes to a sustainable software development process that is able to manage increasing product complexity while still keeping quality high and engineering costs low.

Hardware configuration is an important stepping stone in the path to a finished automation application. In essence, it is a complete description of the hardware on which the software will eventually be required to perform, including everything from controllers and Automation PCs, analog and digital I/O modules, drives and motors to HMI devices for operation and visualization – not to mention safety configurations made up of safety controllers and safe I/O modules.

Drag & Drop – Hardware configuration has never been so easy
Copy & Paste in the hardware tree
System Designer in Automation Studio 4 offers numerous convenient features to help developers master complex hardware topologies. For managing hardware in a traditional tree structure, it draws on familiar methods from the world of IT to maximize convenience and efficiency. Select an unlimited number of system components in the Physical View and set their shared parameters all at once. Move individual hardware nodes or entire branches to modify the configuration using copy/paste or drag-and-drop. The necessary configuration parameters are automatically updated in the background, cutting down on busywork and nipping potential errors in the bud.

Virtual control cabinet
In the System Designer’s visual editor, the system topology is laid out by arranging photorealistic images of the hardware components in a virtual control cabinet and then drawing the connections between them. This intuitive approach makes setting up a hardware configuration quick and easy. All the while, Automation Studio is busy checking plausibility and setting parameters in the background. The graphical view also allows you to easily replicate groups of hardware components, along with all their properties, using drag-and-drop. Connections between components are saved in XML format, which supports automated diagnostics and debugging in addition to making them accessible to third-party systems. A bidirectional interface with EPLAN Electric P8, for example, means configuration data can be entered or modified in either system and synchronized at the push of a button. This mechatronic approach not only reduces the workload, but also eliminates redundant workflows – a notorious source of errors.

The Hardware Catalog makes it easy to find necessary hardware modules quickly.

Highlights
- Creation of hardware configurations using drag-and-drop
- Simple and intuitive system access
- Modules arranged in groups and cable layout generated automatically
- Compatible modules and interfaces identified when adding a new module
Combine programming languages as needed

Automation Studio 4 provides support for all IEC 61131-3 languages in addition to C and object-oriented programming in C++. Smart editors provide context-based suggestions drawn from both included function libraries as well as sections of code that have already been programmed.

Automation Studio shortens the learning curve by allowing developers to work in any of the programming languages defined in the IEC 61131-3 standard – Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart and Structured Text – as well as Continuous Function Chart, ANSI C and the object-oriented programming language C++. These languages can be used in any combination whatsoever. All languages access the same process variables and use the same libraries and data types. In addition, function blocks can be exchanged without any rewiring, while algebraic functions can be entered directly as equations.

Fast and accurate programming is assisted by intuitive editors with integrated SmartEdit functions, outlining, change tracking and user-defined code snippets.
Providing the means to operate machines and monitor their behavior is a core function of any automation solution. Automation Studio 4 includes an integrated package for creating HMI applications that run on all types of hardware — from simple text to Full HD displays keys and/or touch screen.

Integrated HMI programming eliminates the need to purchase additional external tools. Visual editors provide the resources necessary to design the application and how it will be controlled by the device’s keys and touch screen. The Visual Components programming environment includes a full range of controls linked to process variables in the control program.

Visualization applications are created independently of the HMI hardware used — which means they are equally capable of running on a local display, remote terminal or VNC client. This immediately opens up the benefits of remote operation and maintenance with no additional effort.

Visual Components offers a wide range of preprogrammed design elements for process diagrams, the ability to group controls as well as numerous templates that speed up development. Flexible resolutions make it easy to create process diagrams that can be viewed on various displays, while Unicode support allows pages to include Asian characters as well.

**Highlights**

- Platform-independent: Embedded, terminals, Windows, smartphones, etc.
- Screens with flexible resolution
- Direct access to variables
- Unlimited number of languages through Unicode support
- Export/Import functions for external translation
- Extensive libraries of controls and constructs
- Flexible alarm and trend system
- Video and audio playback on Windows® systems
- Display and print of HTML pages and PDF documents
- Run and control any Windows® application
One tool for universal motion control

As production and handling processes become increasingly intertwined and individual machines become more and more powerful, an optimal solution must marry robotics, CNC, coupled axis movements and single-axis positioning. The solution must be able to provide complete motion control regardless of the type of motor used.

In the past, CNC machine control, control for robotic tasks and motion control for single-axis movements were typically treated as strictly isolated domains. Those days are over. Automation Studio provides uniform, transparent access to all types of motion control. Consistent interfaces leave it up to the user to decide what type of drive system to use for a particular motion task – be it a stepper, torque, synchronous, AC or DC motor or linear actuator. The control system generally uses a path generator to calculate the setpoints for all axes centrally, yet parts of this task can optionally be configured to run on the individual drives. This distributes processing where it will be needed at runtime and allows the controller to be dimensioned economically, regardless of how many peripheral devices are equipped on the machine.

Even the most complex motion sequences can be realized with minimal programming by taking advantage of IEC 61131-3 PLCopen motion control function blocks. These can be used to control articulated arm robots or perform intricate 3D CNC processing. The seamless integration of motion control components into the real-time operating system provides direct links to PLC functions and further simplifies the task of building highly complex machines.

**Highlights**

- IEC 61131-3-1 PLCopen motion control function blocks
- Power transmission parameters defined in tables
- Real-time motion analysis using oscilloscope functionality
- Analysis including trace data
- Uniform programming – from stepper motors to servo drives
- Easy access with standardized PLCopen integration
Virtual wiring – Real safety

Automation Studio’s SafeDESIGNER incorporates all of the functions developers need to program and test safety applications using virtual wiring.

Thanks to the extensive PLCopen safety library and an intuitive visual editor, programming a safety application is reduced to the simple task of virtually wiring the certified function blocks provided in SafeDESIGNER. The resulting safety application is then executed on the SafeLOGIC safety controller or implemented as a software-based solution with SafeLOGIC-X for smaller applications.

Despite being fully integrated in Automation Studio, SafeDESIGNER ensures the complete isolation of safety-relevant data and programs. These are stored separately in the Safety Container, which requires special access rights. SafeDESIGNER allows you to design machine options to accommodate all of the various configurations and peripheral equipment associated with a particular machine. A special commissioning license allows on-site technicians to configure the specific set of options required for each target machine. It is also possible to modify the machine’s configuration dynamically after commissioning, simply by importing a new configuration file.

Highlights

- Certified in accordance with EN ISO 13849-1, IEC 62061, IEC 61511 and IEC 61508
- Visual programming in accordance with IEC 61131-3
- Function Block Diagram and Ladder Diagram
- Limited variability language in accordance with ISO 13849-1
- Separate data types for safe and standard variables
- Color-coded lines to distinguish safe and functional signals
- Library with certified PLCopen safety function blocks
- Graphical support during commissioning and validation
- Graphical project comparison
- Complete project documentation
Lock in your software investment

**Highlights**

- Compatibility over many years
- Password protection on the controller
- Only specific parts of a project disclosed
- Directly integrated in Automation Studio
As the complexity of automation tasks increases, so does the value of the time and effort invested in software development. It is essential for customers to secure this asset so that it continues to generate profit for as long as possible and deliver a reliable ROI. Software must also be safeguarded against unauthorized manipulation or reproduction.

One of the keys to the long-term security of an investment in machine software is its compatibility with multiple hardware platforms. Automation Studio manages planning, programming and configuration for all B&R hardware – from the System 2000 and Industrial PC 5000 through Power Panels, Automation PCs and the X20 System.

That’s hardware compatibility that reaches back to 1995. Future platforms will enjoy equally long-term support through Automation Studio and ensure maximum protection for the software it is used to create.

Know-how protection in Automation Studio 4
Software developed with Automation Studio is immune to unlawful manipulation or access. Nevertheless, Automation Studio also features the ability to disclose specific parts of the machine software to a degree that allows users to make any necessary modifications themselves.

Open and safe
Source code can be encrypted to provide restricted access to selected individuals. This feature is integrated in Automation Studio and can be applied to entire projects or limited to certain parts. Authorized end customers can then access only these parts of the project, which is stored on the controller and protected by a password. A modular software design with autonomous modules that run independently on the controller provides another layer of know-how protection. Modules can be programmed, compiled, tested and uploaded to the hardware individually without any prior interaction with the rest of the software.

Since it is no longer necessary to consolidate everything and package it as a complete software solution, there is no security risk involved in allowing machine users to program individual functions or integrate components from third-party developers. These in turn benefit from the protection of their own intellectual property since they are able to provide executable modules in binary form rather than source code.
Series-produced machine manufacturing with software on demand

Fully recognizing the trend towards the flexible customization of series-produced machinery, Automation Studio’s dedication to modular software doesn’t stop at the engineering stage. By providing the ability to upload individual modules to the machine at any time, Automation Studio makes it possible to automatically load and enable a custom version of the automation software as needed by a particular machine configuration. This minimizes the effort of commissioning the software for series production of machinery in batch sizes of one while streamlining upgrades performed in the field.

Implementing customer-specific machine adaptations as late as possible during production is one way that machine builders can reduce costs. The goal of building series machines in batch sizes of one is achieved by offering a range of optional features that can equip a machine to manufacture a particular end product. This modular mechanical design must be backed up by an equally modular software solution that can be customized to match the final machine.

Software on demand: Factory-installed or field upgrade

Modifications to a machine’s mechanical configuration can occur at many stages of its life cycle. This is why B&R’s real-time operating system, Automation Runtime, constantly updates the actual hardware configuration. At initial commissioning prior to delivery, the software can be customized to match the detected configuration, verified against the ordered configuration and transferred to the machine with no manual intervention whatsoever. Only when this step is complete does the operating system start the real-time application. A machine’s configuration can easily change later on, however, when auxiliary options are added or removed in the field. In these cases, the corresponding software modules can be loaded and enabled with all of the convenience of plug-and-play.

Flexible safety included

Dynamic field upgrades are possible for both standard and safety-oriented control equipment. A safety upgrade takes place via a certified process that involves an additional confirmation step when implementing the necessary configuration so that machine options continue to satisfy SIL 3 and PL e requirements.

Highlights

- Generation of custom software during production
- Data point mapping when production begins
- XML format for machine options
- Batch generation of software and configuration from ERP systems
- Plug-and-play capability with the configuration monitor
- Safety configuration modifications up to SIL 3
Hardware and software configurations can be generated depending on the necessary machine configuration. This is one way that Automation Studio 4 turns flexible series production for modular machine concepts into reality.
Integrated online diagnostics
In order to ensure maximum availability, automation systems and machine software must provide transparent access. Automation Studio’s integrated diagnostic tools support developers and users in all stages of a machine or system’s life cycle. Whether accessed on-site or remotely, these intuitive features significantly reduce the time and money spent on service and maintenance.

No external service or diagnostic software is needed to analyze the behavior of a machine or system – all the tools you need are integrated right in Automation Studio 4.

Throughout development and commissioning, the Project Monitor feature provides a helpful comparison between an Automation Studio project and the software installed on the controller, while NC Cockpit offers a full set of commissioning and diagnostic tools for motion axes.

Tool-free system diagnostics over the web
During operation, it is important for analysis and diagnostic data to be available even without a direct connection to Automation Studio. If you have a TCP/IP connection and a web browser, then you have easy access to all of the diagnostic data provided by B&R hardware throughout the commissioning, field testing and operation phases. Using advanced scalable vector graphics, System Diagnostics Manager can be viewed on displays of any size or even integrated in the machine’s HMI application.

In order to get a quick overview of the axes being used in the machine, users have the option of querying axis information in a table. Information relevant to homing, enable status, current velocity and position or the status of onboard inputs is primarily displayed in the form of easily identifiable icons. For more detailed analysis, the status of any axis can be accessed in the System Diagnostics Manager.

No need for electrical measurements
Automation Studio 4 features an integrated I/O viewer that displays the current status of every I/O module in the system. This eliminates the tedious task of checking each I/O point electrically. And because System Diagnostics Manager allows all diagnostics data to be viewed from a central computer, it just makes things that much easier for the B&R support team to perform offline analysis when more in-depth service is required.
Maximum availability through redundancy

Simply by activating the redundancy feature in Automation Studio 4, you can transform a pair of standard X20 controllers into a high-availability system. Achieve maximum availability of your automation system when using POWERLINK by adding ring and cable redundancy.

Potential applications for high-availability systems range from process technology (e.g. in power plants, the chemical industry, etc.) to complete production systems and even standalone machines. In essence, a failsafe system always makes sense when system or machine downtime is expensive or has expensive consequences. Conventional redundant systems have tended to be relatively expensive themselves, however, so they are mostly restricted to process technology applications. Yet with machine downtime becoming increasingly costly, B&R’s sleek solution provides an economical redundancy option that pays off quickly for machine builders as well.

Controller redundancy
PLC redundancy is achieved by coupling two identical Atom™ CPUs from the standard X20 product line. There are no special “redundant controllers” with specific model numbers.

These redundancy capabilities are implemented as a software function that requires nothing but a communication module. Plug-in X20 interface modules form the “redundancy link” and allow the synchronization of data on the two controllers. They also have switches for testing and setting the primary and secondary PLC.

POWERLINK redundancy
Most solutions involve a combination of PLC redundancy, POWERLINK master redundancy and POWERLINK cable redundancy. To guarantee an uninterrupted flow of data in any situation that might occur on the system, each network line must be connected to each PLC.

Simple application development
Redundant systems rely solely on standard components. B&R Automation Studio as the engineering tool and Automation Runtime as the runtime system on the PLC both already provide support for redundancy as a standard feature. Developing applications for redundant systems is generally no different than for non-redundant systems. A simple switch in the engineering tool defines whether a system is redundant or not. The rest is handled by Automation Studio and Automation Runtime. This structure and level of integration makes it easy to upgrade a system with one PLC to a redundant system.

Highlights
- Minimal switching times
- Redundancy with standard hardware
- Seamless integration
- One-click configuration
- Hot plugging CPU replacement without downtime
The APROL process control system

With its flexibility and diverse functions, the APROL process control system is the optimum platform for automation solutions in a wide range of fields.

APROL is distinguished by its scalable architecture, its unified and completely integrated engineering environment and its exceptional performance. Maximum reliability and availability are achieved through an array of powerful system functions paired with the use of proven series products. Custom out-of-the-box solutions maximize flexibility while minimizing the time and cost of engineering. With an intuitive HMI system as the foundation, the integrated alarm, trend and reporting systems form the pillars of a seamless solution for the acquisition of operational and process data.

Plant automation
Standardized system components developed with object-oriented programming make it possible to modularize entire systems. This in turn substantially reduces commissioning times and cost. Centralized project management together with a standardized library makes maintaining systems around the world both easier and more efficient. System availability is maximized by secure, integrated remote access to all system components for maintenance, service and upgrades.

Factory automation
Centralized management of data from every module in a production line allows for comprehensive online performance monitoring and visualization. The ability to manually control individual production modules separately or automatically coordinate all modules together provides the flexibility to fine-tune the optimum operating strategy for any system. Tracking the flow of materials allows each completed production step to be traced seamlessly at any time.

Energy monitoring
Data is collected from all possible energy sources via multiple interfaces (Profibus PA field devices, Modbus, etc.) and I/O components (HART, pulses, etc.) to provide comprehensive and automatic energy monitoring functions. Energy management systems as defined in ISO 50001, EN 16001, etc. are easily implemented with automated energy monitoring and detailed measurement and display of consumption and cost data.

Process control
Enjoy reduced engineering, operation and maintenance costs over the entire life cycle of your system thanks to this fully integrated process control system. Integrated version management and the “Change” control simplify and streamline the process of validating your systems in accordance with FDA, GAMP5 and other applicable requirements. Integrated alarm and trend systems provide complete documentation, display and evaluation of all process data and ensure complete transparency without requiring additional costly expert systems.
### Inside Automation Studio 4 – Core features

#### Product description
- **Supported operating systems**: Windows XP, Vista, 7, 8
- **Project development**: PLC and PC-based control systems
- **Runtime system**: Integrated

#### Programming
- **IEC 61131-3 programming languages**: Ladder Diagram (LD), Function Block Diagram (FBD), Structured Text (ST), Sequential Function Chart (SFC), Instruction List (IL)
- **Language extensions / High-level languages**: Continuous Function Chart (CFC), ANSI C, C++
- **Additional editors**: System Designer, CAM Editor, Servo Loop Optimizer
- **3rd-party integration**: Model-driven engineering, MATLAB/Simulink, MapleSim, EPLAN Electric P8, WINMOD
- **Debuggers**: Source level debuggers, breakpoints, Watch window, call stack, Trace window, logbook, Profiler, network diagnostics, system dump
- **Integrated simulation**: Control, visualization, axes, I/O, safety
- **Project management**: Integrated in Automation Studio, team support, source code management, concurrent development of self-contained projects, parallel commissioning on one controller
- **Integrated fieldbus configuration**: POWERLINK, CANopen, DeviceNet, Ethernet/IP, Modbus TCP, PROFINET, support for GSD, EDS and FDT/DTM
- **Technology functions**: Feedback, temperature, hydraulic, winder, registration mark and register control, condition and energy monitoring, kinematics, CNC, robotics

#### Runtime environment
- **Number of task classes**: 8 absolutely deterministic and time-synchronous
- **Configurable cycle time**: 50 us and higher
- **Remanent memory**: Buffered up to 1 MB
- **Integrated UPS**: Yes
- **Application memory**: CompactFlash
- **Integrated fieldbus systems**: POWERLINK, CANopen, DeviceNet, Ethernet/IP, Modbus TCP, PROFINET
- **Multi-core support**: Yes
- **Multi-OS support**: Yes
- **Multi-project support**: Projects stored separately in memory
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System diagnostics</td>
<td>Integrated, access via standard web browser, can be integrated in any HMI application</td>
</tr>
<tr>
<td>Integrated connectivity</td>
<td>SQL, HTTP, OPC UA, Classic OPC, SMTP, TCP, UDP, fieldbus systems, Automation Net / PVI, FTP</td>
</tr>
<tr>
<td>Redundancy</td>
<td>PLC, cable, ring</td>
</tr>
<tr>
<td>Integrated HMI</td>
<td>Unicode support, unlimited number of languages, IME support, able to load languages at runtime</td>
</tr>
<tr>
<td>Language switching</td>
<td>Up to Full HD</td>
</tr>
<tr>
<td>Graphics resolution</td>
<td>JPG, BMP, 32-bit PNG, transparency</td>
</tr>
<tr>
<td>Supported graphic formats</td>
<td>Unlimited number, reports, alarms, acknowledgment, filters, configurable history</td>
</tr>
<tr>
<td>Alarm system</td>
<td>Unlimited number, display up to 16 curves simultaneously</td>
</tr>
<tr>
<td>Trend system</td>
<td>Integrated VNC server, terminal server</td>
</tr>
<tr>
<td>Remote operation</td>
<td>Local/Terminal HMI, VNC visualization, Windows visualization</td>
</tr>
<tr>
<td>Display</td>
<td>PLCopen IEC 61131-3, CNC interpreter in accordance with DIN 66025 and Structured Text (ST)</td>
</tr>
<tr>
<td>Programming languages</td>
<td>Frequency inverters, servos, steppers, DC motors, hydraulics, fully scalable and interchangeable</td>
</tr>
<tr>
<td>Supported drive systems</td>
<td>Network, I/O</td>
</tr>
<tr>
<td>Functions</td>
<td>Point-to-point, gearboxes, cam profiles, CNC, robotics</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Motion Trace window, Watch window, axis test, logbook, command trace</td>
</tr>
<tr>
<td>Simulation</td>
<td>Drive and load simulation, Servo Loop Optimizer, speed-torque curves</td>
</tr>
<tr>
<td>Integrated motion control</td>
<td>Visual editor (limited variability language in accordance with ISO 13849-1): Ladder Diagram (LD), Function Block Diagram (FBD)</td>
</tr>
<tr>
<td>Certification</td>
<td>ANSI C (full variability language in accordance with ISO 13849-1)</td>
</tr>
<tr>
<td>Performance classes</td>
<td>SIL 3 / PL e / CAT 4</td>
</tr>
<tr>
<td>IEC 61131-3 programming languages</td>
<td>PLCopen safety, SafeMC, SafeROBOTICS</td>
</tr>
<tr>
<td>Language extensions / High-level languages</td>
<td>TCP/UDP, FTP, Runtime Utility Center control project, visualization application, motion control, operating system, firmware for PLC hardware and drives</td>
</tr>
<tr>
<td>Libraries</td>
<td>System Diagnostics Manager, VNC, Web, HTTP</td>
</tr>
<tr>
<td>Web server</td>
<td>Integrated</td>
</tr>
<tr>
<td>Auxiliary interfaces</td>
<td>GSM, UMTS, SMS, email</td>
</tr>
<tr>
<td>Access via variables</td>
<td>OPC UA, Classic OPC, Automation Net/PVI, .NET interface</td>
</tr>
</tbody>
</table>
For every industry

Automation Studio 4 is the ultimate integrated automation software for every industry. When it comes to efficient and sustainable software engineering for machines and systems, Automation Studio offers the power and versatility to optimize every horizontal and vertical aspect of your system and the openness to secure its value long into the future.

Manufacturers face unyielding pressure to raise the level of automation in their production lines, with individual machines becoming increasingly automated as well. When it comes to integrating handling equipment, robots and the transport systems that connect them, it makes no difference whether you’re running a production hall or processing plant. The logical next step is to merge individual subsystems with automated control of the entire system at a supervisory level to close any gaps between processes.

Methodological differences from industry to industry are fading. Control algorithms and production sequences have many similarities, whether processing metal or wood, whether printing on textiles, plastic or paper or converting them into packaging, or whether producing or packaging pharmaceutical, food and beverage or tobacco products. On the other hand, there are most certainly industry-specific differences, as indicated by different applicable standards.

The Automation Studio 4 development system integrates every aspect of automation, providing uniform solutions for open and closed loop control, motion control and safety technology as well as hardware and software for operating and monitoring entire systems from the highest supervisory level down to individual sensors and actuators. The features it provides and the systems it is used to create are suited for all industries, support compliance with relevant standards and are certified by the respective industrial governing bodies.

A selection of technology packages provides pre-programmed open loop, closed loop and motion control technology as well as visualization solutions for typical industry-specific system components, making it easy for software developers to create solutions optimized for particular industries.

Integrated automation software for every industry:

01 Commercial vehicles, 02 Infrastructure, 03 Metal, 04 Handling & Robotics, 05 Print, 06 Wind power, 07 Maritime & Offshore, 08 Tobacco, 09 Packaging, 10 Environment & Recycling, 11 Chemicals & Pharmaceuticals, 12 Food & Beverages, 13 Semiconductors, 14 Oil & Gas, 15 Measurement and testing technology, 16 Energy, 17 Wood, 18 Medical engineering, 19 Plastics, 20 Textiles, 21 Automotive
The high-performance POWERLINK real-time communication solution is based on the IEEE 802.3 Ethernet standard and designed to ensure real-time data transfer in the microsecond range.

**Flexibility**
POWERLINK provides optimum flexibility for both centralized and decentralized architectures. Its hot plugging capability allows modules and components to be connected and disconnected as needed during operation. This has no impact on real-time behavior and does not require restarting the system, which saves time and money. Flexible cabling allows you to decide which topology best meets the needs of your system. Nothing stands in the way of upgrading your machine or system or continually expanding your machinery.

**Performance**
Highly efficient cross-communication and network topologies with distributed intelligent sensors and actuators help minimize jitter and ensure fast response times. The efficiency of POWERLINK makes it possible to implement high-speed control loops centrally via the bus, greatly simplifying engineering. The advantages are clear: save time, simplify systems and relieve the load on control tasks.

**Reliability**
In safety-critical real-time applications, POWERLINK proves itself as an extremely robust system with a high level of immunity to electromagnetic disturbances. The most demanding field conditions require a system’s mechatronic components to operate with utmost reliability, yet they also require the bus to ensure data transfer even if an error occurs.

**Return on investment**
Based on IEC standards and supported by the internationally active Ethernet POWERLINK Standardization Group, POWERLINK guarantees compatibility anywhere in the world. As an open solution, POWERLINK is unpatented, software-based technology that is completely independent of proprietary hardware. Its scalability and ability to integrate all types of systems make POWERLINK a perfect solution for any industry.
openSAFETY is a global IEC standard that ensures fast and absolutely reliable transfer of safety-related data regardless of the controller and fieldbus being used – providing a unified safety standard across entire machine lines.

The advantages are many. Combining faster response times with smaller safety clearances means increased productivity, which is enormously important for machine builders. System operators profit from faster commissioning and changeover times thanks to automated parameterization and configuration services. And with openSAFETY, you’re always on the safe side – TÜV Rheinland and TÜV Süd have both awarded this technology SIL 3 certification for satisfying international IEC 61508 requirements.
Optimize your system

B&R offers an extensive range of products for delivering integrated automation solutions. For a complete overview of all B&R system components, visit www.br-automation.com

Motors
- Broad range for diverse applications
- Synchronous motors
- Direct drives (torque motors)
- Stepper motors
- Power range from 50 W to 140 kW
- Optimum system integration with embedded parameter chip

Gearboxes
- Extensive product range
- Flexible building block principle for standard gearboxes
- Low backlash and high torsional rigidity with premium gearboxes
- Direct gearbox mounting
- Maintenance-free

I/O systems outside the control cabinet
- X67 I/O
- Compact and ergonomic
- IP67 protection
- Excellent EMC properties
- Open for all fieldbus systems
- Seamless integration of IP20-rated I/O

Scalable PLC platform
- X20 PLC
- Intel® Atom™ performance
- Fan-free and maintenance-free
- Onboard POWERLINK
- Onboard gigabit Ethernet and USB
- Modular interface expansions
- Extremely compact
- Redundancy support

Modular I/O system
- X20 I/O
- Removable terminal blocks
- Hot-pluggable electronics
- Unequaled component density
- 16 channels with total width of only 12.5 mm
- Open for all fieldbus systems
- Seamless integration of IP67-rated I/O

Compact drives
- ACOPOSmicro
- Stepper motor control
- Servo motor control
- Power range up to 500 W
- Compact design
- Extremely versatile

Frequency inverters
- ACOPOSinverter
- Power range from 180 W to 500 kW
- Complete integration into overall system
- Automatic parameter download
- Integrated safety functions (STO, SLS, SS1)

Drive systems
- ACOPOS/ACOPOSmulti
- Energy regeneration and savings
- Power range from 500 W to 120 kW
- Compact and scalable
- Modular cooling design
- Integrated technology functions
- PLCopen motion function blocks
- Integrated safety technology and SafeMC
**Safe motion control**
- SafeMC
- ACOPOSmulti/ACOPOSremote/ACOPOSmotor
- 16 safe drive functions (STO, STO1, SBC, SOS, SS1, SS2, SLS, SDI, SIL, SMS, SLP, SMP, SBT, SLT, Safe Homing, Safe Robotics)
- Safe parameter transfers with SafeLOGIC
- Fastest response times (<7.2 ms)
- SIL 3/PL e/CAT 4

**Distributed drive system**
- ACOPOSremote
- Seamless integration in the ACOPOSmulti drive system
- High continuous power up to 4 kW
- Integrated connections for I/O nodes
- Flexible topology (tree or daisy chain)
- Integrated safety technology and SafeMC

**Decentralized servo actuator**
- ACOPOSmotor
- Seamless integration in the ACOPOSmulti drive system
- Three sizes from 1.8 to 10.5 Nm
- Available with or without add-on gearbox
- Reduced wiring
- Integrated safety technology and SafeMC

**Safe controller**
- SafeLOGIC
- Virtual wiring
- Integrated diagnostics
- Management of machine options
- Scalable
- SIL 3/PL e/CAT 4

**Safe I/O**
- X20 SafeIO/X67 SafeIO
- Digital inputs/outputs
- Relay outputs
- Analog inputs
- Temperature inputs

**Box PCs**
- Automation PC
- Powerful Intel® Core™ i3/i5/i7 processors
- Best graphics performance
- Fan-free operation
- Modular interfaces
- Uncompromising quality for operation over many years
- Windows 7, Windows XP, Linux, real-time

**Panel PCs**
- Panel PC 900
- Projected capacitive multi-touch and analog resistive single-touch screens
- Gloved operation possible
- Powerful Intel® Core™ i3/i5/i7 processors
- Slim design
- Extensive product range up to 24" Full HD
- Fixture and support arm variants

**PC-based panels**
- Power Panel
- Control and HMI in one device
- From 5.7" QVGA to 15" XGA
- Touch screen and keys
- Excellent EMC properties
- Modular expansions
- Windows 7, Windows XP, Windows CE, real-time

**Mobile automation**
- MA170 system
- Modular control and I/O system
- Extremely robust housing and hardware
- -40 to +85°C temperature range (housing surface)
- 8 to 32 VDC power supply
- Extreme shock and vibration resistance
- POWERLINK & CANopen

**Automation Studio 4**
Integrated automation
Global presence
Solid partnership