the power to control

bachmann.

Energy Technology Automation

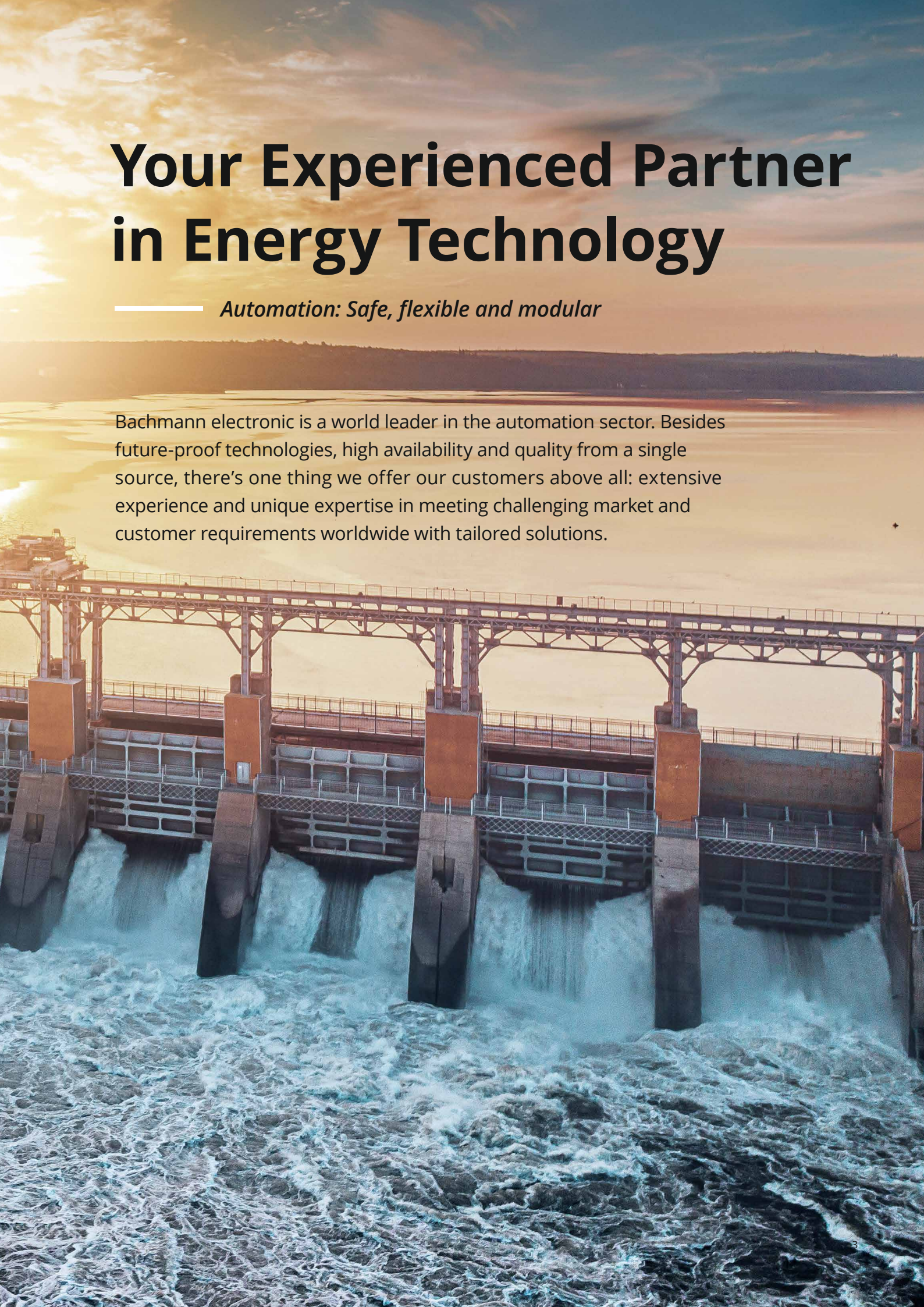
Simple. Sustainable. Secure.

energy.industry.maritime.

Your Experienced Partner in Energy Technology

Automation: Safe, flexible and modular

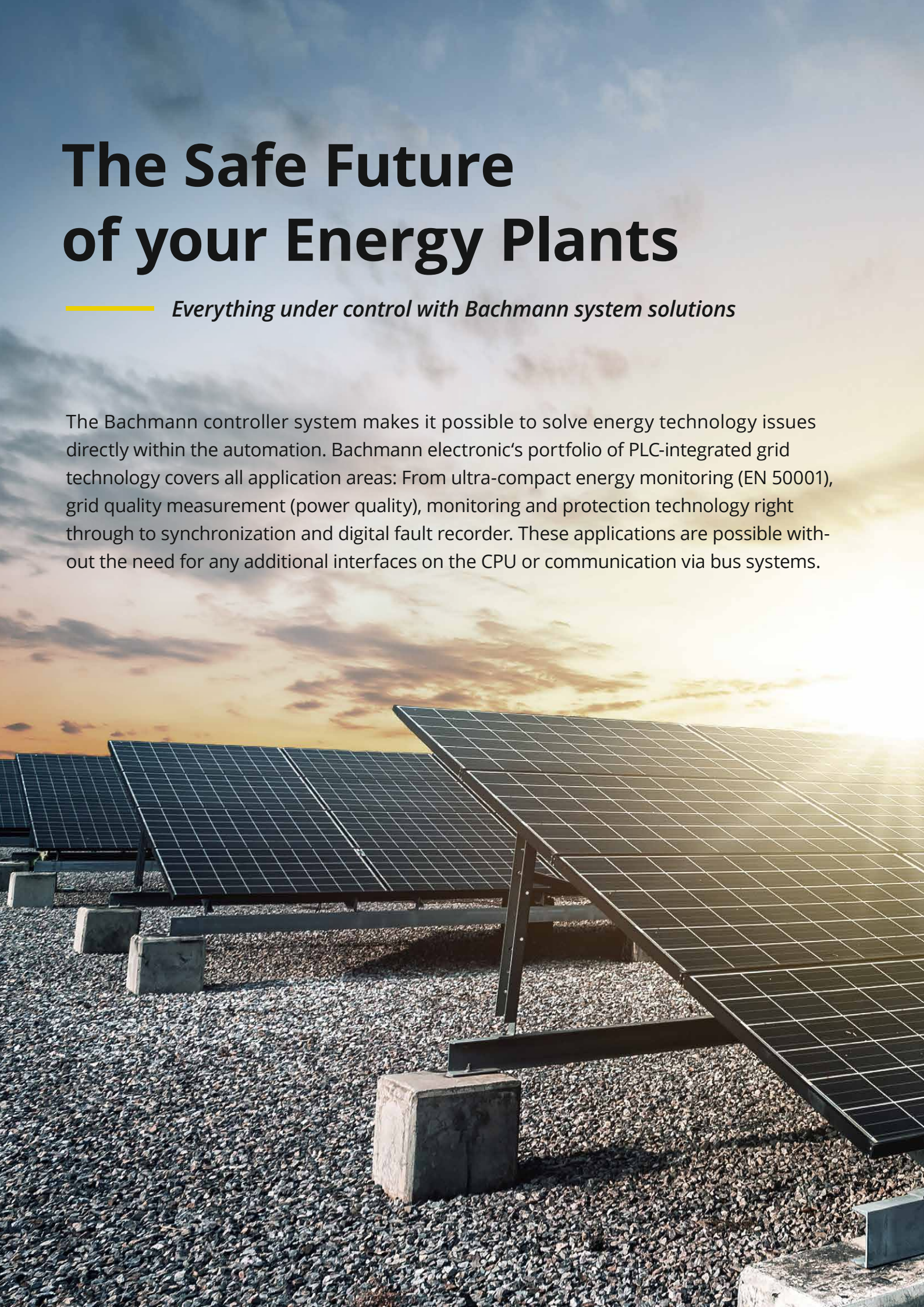
Bachmann electronic is a world leader in the automation sector. Besides future-proof technologies, high availability and quality from a single source, there's one thing we offer our customers above all: extensive experience and unique expertise in meeting challenging market and customer requirements worldwide with tailored solutions.



The Safe Future of your Energy Plants

Everything under control with Bachmann system solutions

The Bachmann controller system makes it possible to solve energy technology issues directly within the automation. Bachmann electronic's portfolio of PLC-integrated grid technology covers all application areas: From ultra-compact energy monitoring (EN 50001), grid quality measurement (power quality), monitoring and protection technology right through to synchronization and digital fault recorder. These applications are possible without the need for any additional interfaces on the CPU or communication via bus systems.



Wind energy and condition monitoring

- More than 140,000 wind turbines automated with Bachmann worldwide
- More than 10,000 Condition Monitoring Systems installed with Bachmann
- More than 250 automation partners trust Bachmann in the wind sector

Customers: Vestas, Nordex, eno energy, Sany, Abo Wind, BKW Wind Service ...

Battery storage systems and hybrid power stations

- Support of open and standard interfaces/protocols
- Modular system in the hardware and software
- Integrated grid measurement and analysis

Customers: Younicos, Qinous, Gildemeister energy storage, Schäfer Elektronik ...

CHP

- Scalable controller system
- Grid synchronization integrated in the Bachmann controller
- Certified to VDE-AR-N 4105, BDEW FGW TR3 and TR8
- CHP Template – 80 % of the software is "ready-to-use"

Customers: 2G Energy AG, COMUNA-metall, enertec Kraftwerke, Bayern BHKW ...

Hydropower

- Standard telecontrol protocols – Integration in virtual power stations in compliance with the 60870-5-101/103/104, MMS 61850-7-420
- Robust system – ensures high availability
- 48 hour "run-in test" of all modules
- Seamless web visualization of webMI pro via atvise® scada right through to atvise® portal

Customer: Rittmeyer

The Future in View

Our automation solutions set new standards – worldwide and around the clock

With an innovative mindset driven by years of experience and a passion for knowledge, we focus our attention on four areas:

b.control

Automation: Scalable. Robust. Versatile.

Thinking further, always keeping one step ahead, staying open for everything that the future will bring – this is our mission at Bachmann and what makes our automation solutions so special. A holistic system, perfectly tailored to the individual requirements of our customers – today and in the future. The core of every Bachmann system solution is the Bachmann automation system: a modular hardware and software concept that guarantees maximum availability, future investment security and engineering efficiency.

b.grid

Grid Measurement, Protection and Control: Safe. Fast. Stable.

A scalable range of integrable, multifunctional power meters are available as plug-in modules for the Bachmann automation system. The measurement of all characteristic grid variables such as voltage, current, power or frequency directly within the control system allows significant correlation with other operational data, as well as an excellent reaction time. The measured data is rapidly calculated without additional delays due to fieldbusses or transceivers.

b.operate

Visualization and Operating:
Visualize. Web compliant. Versatile.

In the automation industry, approaches such as Industry 4.0 and the associated breakdown of the rigid automation pyramid are widely discussed but rarely followed through. Unfortunately, solutions closely following this rigid principle are still frequently found in the field. The visualization solutions from Bachmann take a different approach. To advance the digitization in automation, our solutions focus on flexibility and freedom.

b.guard

Condition Monitoring System:
Planning. Detecting. Preventing.

A Condition Monitoring System (CMS) integrated in the automation system can provide all information, in order to detect failure hazards early on and plan maintenance tasks in good time. With increasingly competitive markets and industries, companies are challenged to run their organizations with ever more output and greater efficiency. Knowing the health of assets has become key to increasing company productivity and profit.

The Bachmann Automation System

The automation solution for energy applications

We understand the big picture and are always thinking ahead for you. Our innovative solutions ensure efficient engineering of your plants. This is what the intelligent automation of state-of-the-art energy plants looks like.

Top Technology without Limits

Automation

Automate your energy plant with Bachmann, secure in the knowledge that every eventuality is covered. Our innovative automation systems stand out on account of their extraordinary robustness, high performance and open interfaces.

Openness in hardware and software

The Bachmann automation system operates as a real-time system. Different open-loop and closed-loop control programs are adapted in modules and run simultaneously in a preemptive multitasking environment. Like the hardware, the software system is also modular and can be structured and extended as required following our "no limits" principle. The controller offers additional reserves for expansions or plant-specific modifications.

Functionality means "ready-to-use"

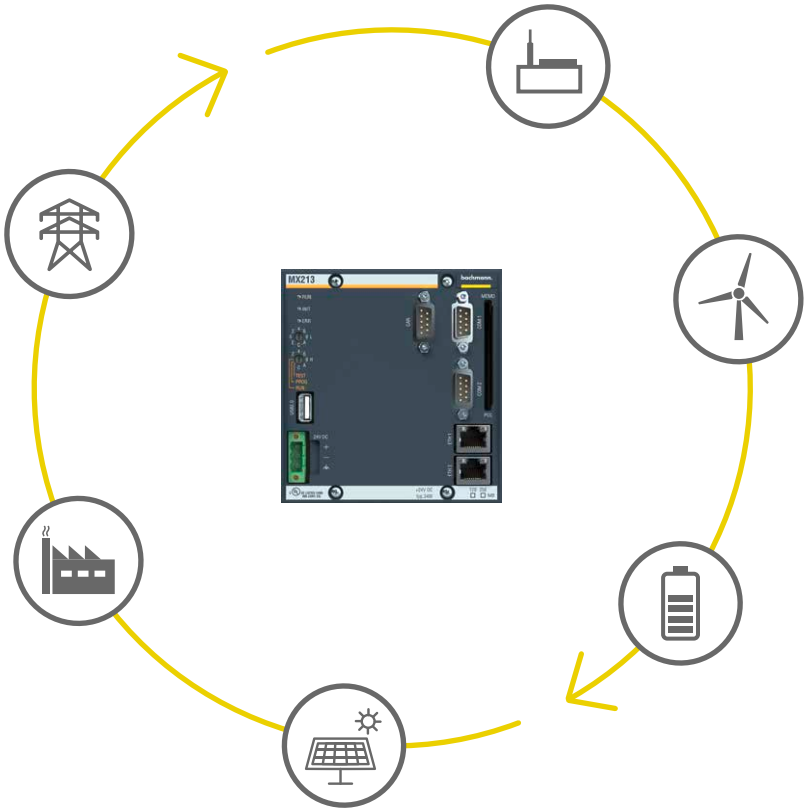
The modular Bachmann controller system offers an extensive range of hardware, consisting of over 200 devices and modules. This system contains a large number of configurable blocks for all necessary machine functions, such as visualization, networking, closed-loop control and diagnostics, to provide you with all the basic functions from the start. Here we place tremendous importance in the fact that all tools have been developed according to international standards, and can also be integrated and parameterized flexibly.

Equipped for challenging climates

The ColdClimate modules of Bachmann are the solution for all applications in demanding climatic conditions, especially where maximum plant availability is critical. The ColdClimate modules are first choice, especially when demanding environmental conditions (e.g. temperature, air humidity, salt spray) are involved. For you this means: Safe operation, even with extreme transient temperatures from -40 to +70 °C, and reliable continuous operation guaranteed in the temperature range from -30 to +60 °C with condensation.

System concept: Scalable and open

In order to minimize complexity and maximize ease of maintenance, all components of the Bachmann controller system are consistently developed as part of a modular system. In this way, optimum scalability is ensured for a wide range of requirements. The Bachmann controller system perfectly combines the openness of a PC-based controller with the reliability of industrial hardware platforms. A state-of-the-art system architecture designed for effective networking capability enables it to be integrated easily in the area of the controller and plant peripherals.



The openness of the overall system makes it possible to integrate third party systems and components without any problem. A wide range of fieldbuses and telecontrol protocols are available for this. These can be selected as required without having to change the automation.

IEC standard benefits

IEC 61850 – A standard communication solution for easy access to relevant energy plant data.

Certified systems

Internationally accredited test institutes verify the conformity of our systems with the most important global standards and thus provide approval for the most demanding applications.

FGW TR3 FGW TR8

VDE-AR-N 4105

BDEW IEEE Std. C37.90

A System for every Requirement

For fault-free operation

Digital input/output modules – DIO

The DIO248, DIO264 and DIO280 digital I/O modules are suitable for controlling digital consumers such as contactors, relays, pneumatic and hydraulic valves, as well as for reading the signals of digital sensors, probes or switches. The eight interrupt inputs provided enable a rapid response to any events. Alternatively up to four counters are available for tasks such as position detection or counting items. All outputs can be operated as PWM outputs for the energy saving operation of inductive loads. A stop time of 0 to 2 s can also be configured for PWM operation. Outputs can be switched in parallel if they are run in the same operating mode.

CPUs of the MX series

Maximum performance for demanding closed-loop control tasks, process control and signal processing, as well as a comprehensive range of communication protocols – all provided by the CPUs of the MC model series: state-of-the-art Intel processors, fast GBit networks, large CFA memory, battery-backed, nonvolatile data storage (NVRAM), Ethernet, serial and USB interfaces.

GIO I/O module

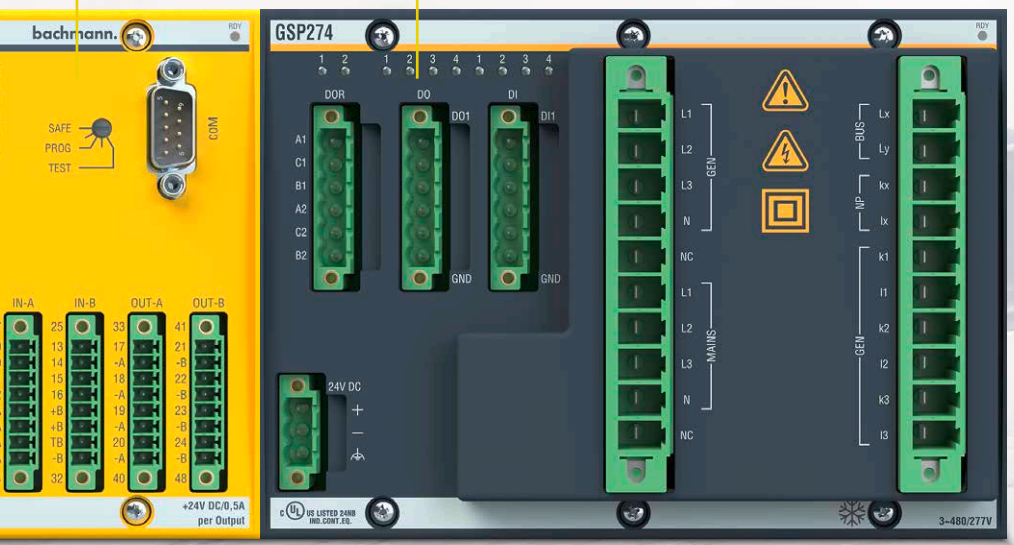
The GIO212 can measure or output different types of signals. Each channel can be used as an analog or digital output or input. Different sensors and actuators can be connected with current (0/4 to 20 mA) and voltage (±10V) standard signal types.

SLC safety processor module

The SLC284 – ideally integrated in the Bachmann controller – is a safe and modern safety controller. The SLC284 is approved in accordance with the latest IEC 61508 safety standard. No additional cabling is required for communication between SLC284 and the SDI208 and SDO204 safety input/output modules. The modules can be operated remotely – several hundred meters apart – distributed via the bus expansion or a FASTBUS.

Grid measurement, synchronization and protection – GSP274

The GSP274 enables the safe, reliable and automatic synchronization of generator units to the power supply grid. It also provides a number of monitoring functions for generator and grid protection. The circuit-breakers are tripped by the module directly via digital outputs and relays. Additional digital inputs enable the monitoring of the relevant switching state. The continuous monitoring of grid harmonics up to the 50th harmonic can be used for direct responses as well as for evaluating the power quality.



COLDCLIMATE
-40 TO +70 °C

- *Very large operating temperature range*
- *High moisture condensation resistance*
- *Use of modules at extreme temperatures from -40 to +70 °C*
- *100 % "run-in test" for all modules with extreme temperature changes in climatic chambers*

More on this topic is provided on our website

All-in-one Engineering

SolutionCenter

The Bachmann SolutionCenter represents a genuine milestone in the reduction of engineering costs. A single all-round software solution covers all areas of the engineering process – from configuration, programming, closed-loop control, motion, communication, safety, visualization, right through to testing and commissioning.

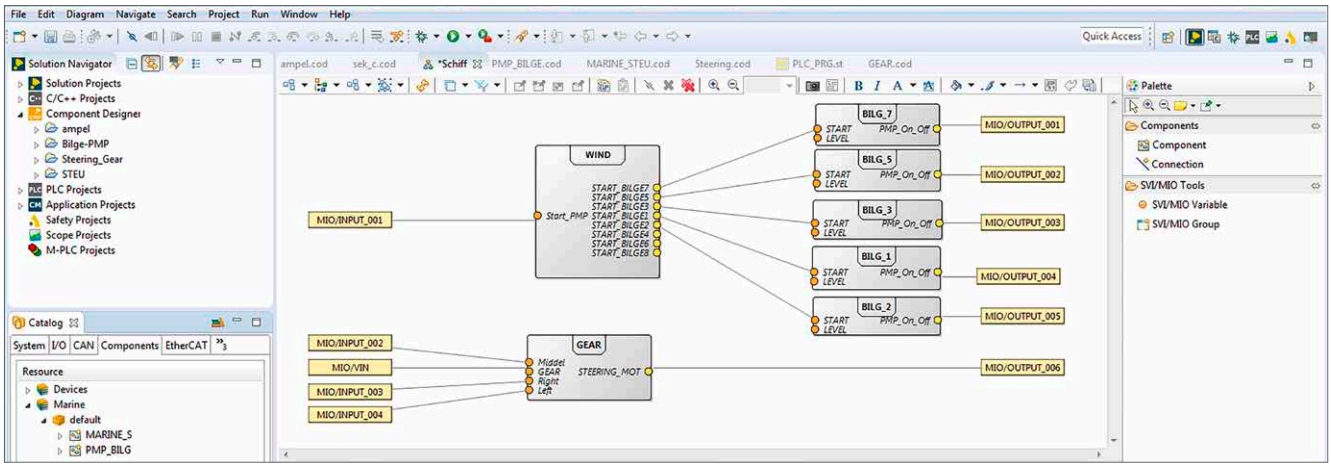
SolutionCenter – the all-in-one engineering tool

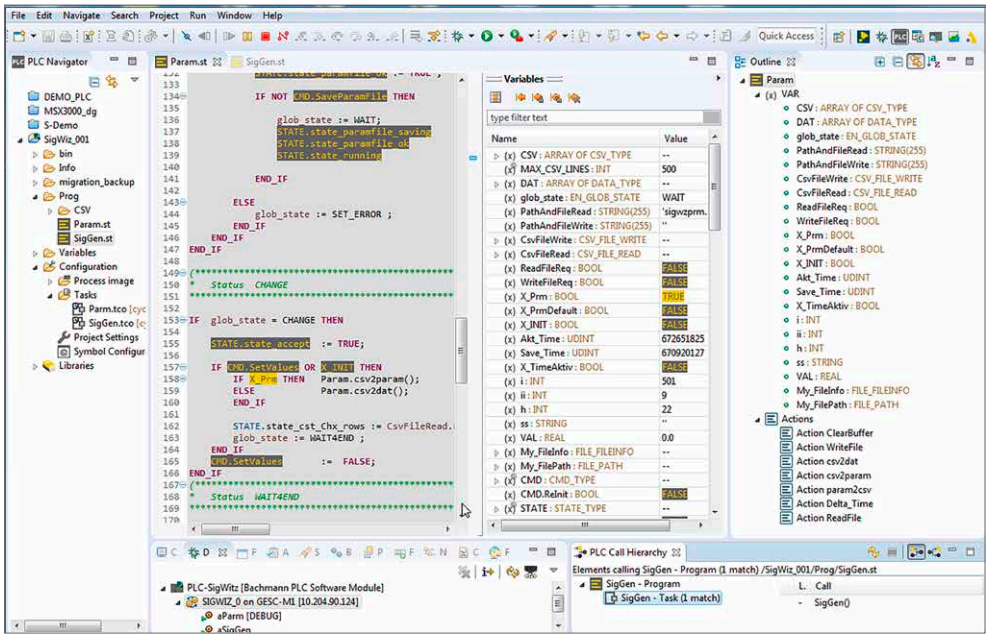
The SolutionCenter supports all aspects of the engineering for wind power applications and perfectly integrates to Bachmann devices and systems. It was designed in collaboration with experienced users and allows effective engineering in all phases. Through the plugin concept, the SolutionCenter enables necessary functions or user-specific requirements to be added at any time. This can be done either by selecting a third-party plugin from the extensive offering or with in-house developments.

Component Manager

More than ever, modern plants consist of complex mechatronic systems, which can only be implemented through the close collaboration of all the engineering sciences required for the process. This complexity is handled by breaking down the plant into logical function units, also known as components. Bachmann's Component Manager is designed for this task. The tool allows you to form systems from different components, which are depicted as software modules in the system. These components can not only be created in the optimum programming language for your task but can be also pur-

Component Manager:
Clear application display in the SolutionCenter.



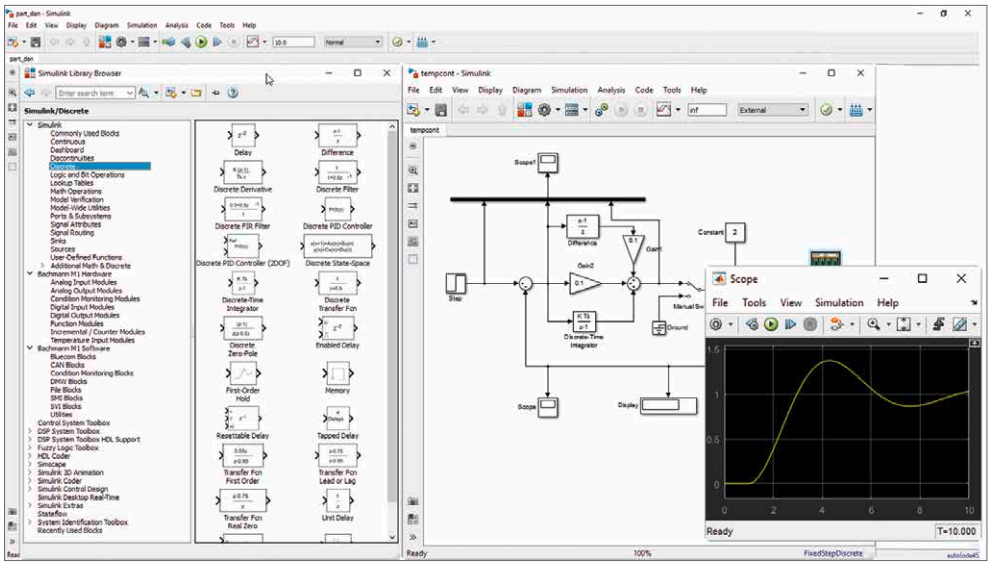


PLC Developer: Modern editor for IEC 61131-ST fully integrated in the SolutionCenter.

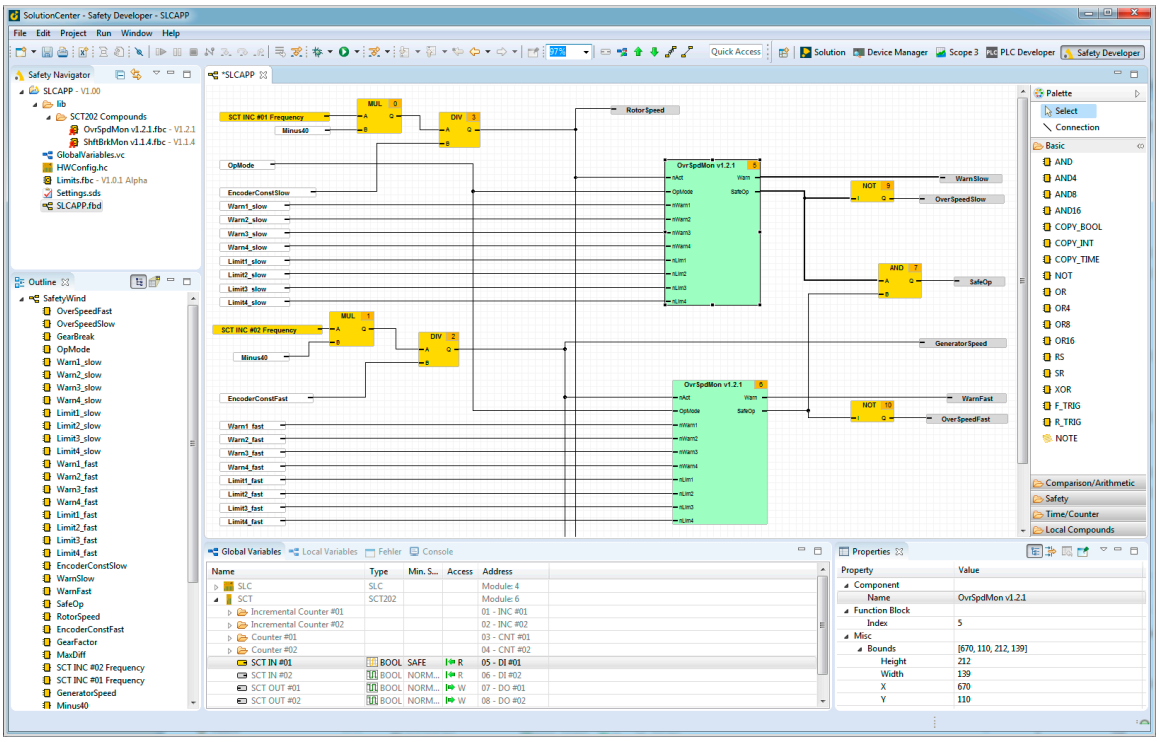
chased and reused. This makes it possible to add new custom versions, product versions or new functions (different software module combinations, additional modules...) without modifying the existing software. This methodology makes use of modern tools to support the engineering process. Through the plugin concept, SolutionCenter makes it possible to use all common versioning systems (SVN, GIT etc.) and manage the entire history of the project with all its components.

Programming tools

The SolutionCenter provides modern programming environments for creating the software modules. Automation tasks and requirements can be addressed both with the new PLC Developer tool from Bachmann as well as with the proven M-PLC Tool in IEC 61131. Programming in C/C++ at the same time in the form of autonomous modules or as libraries for the PLC environment is also possible. Simulations and closed-loop control tasks can be modeled and simulated with MATLAB®/Simulink®. The M-Target Toolbox and interface developed by Bachmann ensures perfect integration in the Bachmann automation target system. Extensive libraries are available in any programming language for a variety of different tasks.



MATLAB®/Simulink®: Development of open and closed-loop control programs for the Bachmann automation system using the M-Target Toolbox.



Seamless integration: The complete integration in the SolutionCenter reduces the time required for the configuration and reduces downtimes, thanks to the simple remote diagnostics and onsite troubleshooting – safety integrated.

BENEFITS

Simple

- *Seamless and flexible operating concept*

Efficient

- *No redundant or unnecessary manual entries*
- *Reuse on all engineering levels*
  - *Program code*
  - *Configurations*
  - *Diagnostics*

Universal

- *One tool for all areas of engineering*
  - *Configuration*
  - *Programming*
  - *Diagnostics*
  - *Testing*

More on this topic is provided on our website

Test/quality/simulation

Quality assurance tests must be carried out during and after software development. The SolutionCenter supports the programmer while performing extensive software test procedures (unit test, static code analysis...) as well as when testing the application software. The component-oriented design of the application program enables targeted testing. Software can be tested as a complete application or as individual software modules. For these tasks, processes based on CSV tables, as well as extensive processes such as hardware-in-the-loop (HIL) are available.

Security/safety

Plants in the energy sector must comply with stringent security and safety standards. This involves both the area of unauthorized access to the controller as well safety shutdowns in dangerous conditions. SolutionCenter allows the configuration of extensive security features and provides the Safety Editor as an easy to use tool with the CFC Editor for programming a software control program integrated in the Bachmann automation system. A wide range of libraries with compliant modules are available for the rapid implementation of the safety application. This includes the exchange of variables with the operational control program. The integration of the safety engineering in the turbine controller enables remote diagnostics and maintenance to be carried out easily.

Communication

Modern plants are no longer possible today without the implementation of a network. The Bachmann controller supports all commonly available networks, fieldbuses and protocols, such as Ethernet TCP/IP, PROFINET, EtherCAT, CAN bus or Modbus, IEC 61400-25, IEC 60870-5-104 or OPC UA. The configurators required are also included as well as diagnostic and testing tools.

Visualization

The increasing complexity and constantly rising level of automation in different plants require the use of HMI and SCADA systems. These systems support both very small applications, with only a few dozen data points, as well as large-scale plants with several 100,000 process

variables. Visualizations are required to adapt quickly and effectively to the requirements of the application. SolutionCenter provides solutions for this based on standard technologies (OPC UA, HTML5 ...).

Diagnostics

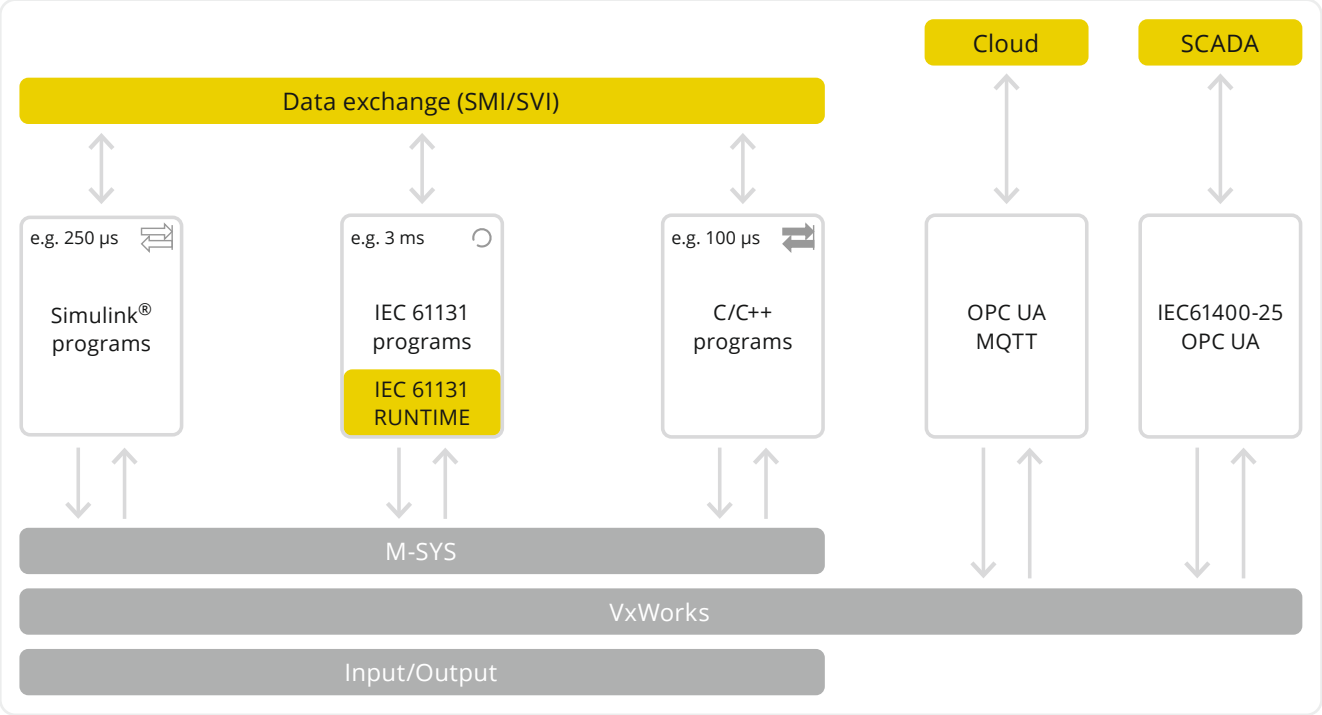
In all engineering phases, SolutionCenter offers an interface to all the information about the plant. With dynamic processes, the display of physical variables as numerical values is often not enough. The "Scope 3" Software Oscilloscope enables automatic long-term archiving (logging) as well as the automatic recording of sporadically occurring events in relation to other process variables.

The acquired data can be archived in a database for subsequent processing. "Scope 3" is fully integrated in the SolutionCenter. This for example enables Scope recording configurations to be assigned to a project and managed in the integrated version manager.

Operational control

During the operating phase, SolutionCenter provides support with a clearly arranged display of all turbines and subsystems. The actual operating state as well as all necessary parameters are clearly displayed. SolutionCenter provides all the turbine data and information required for the operation of the plant.

Comprehensive engineering: Basic structure of the Bachmann automation system for open and flexible design using standardized software modules.



The Fast Way to Reliable Diagnostics

Scope 3 data recorder and watch list

Regardless of whether during commissioning, troubleshooting or maintenance – the more modern and complex the automated plant, the more important the transparency of information on process states and sequences in the overall system becomes. The Bachmann SolutionCenter provides users of the Bachmann automation system with all the diagnostics tools needed in one software solution and keeps all the data reliably in view – in real time.

BENEFITS

- *Autonomous real-time data acquisition on the controller*
- *Long-term archiving by database configurable*
- *Number of recorded signals only limited by hardware resources*
- *High resolution (from 100 microseconds) and variable sampling priority*
- *Several trigger options as well as pre-trigger and post-trigger functions*
- *Data analysis with outstanding PC software*
- *Recalculation of logged data (standard algorithms, user-defined algorithms)*
- *Seamless integration in M1 webMI pro web visualization*

More on this topic is provided on our website

Scope 3: Data recording at high speed

With many dynamic processes, the display of a physical variable as a numerical value is not enough. The latest software oscilloscope generation from Bachmann, "Scope 3", shows the values of processes over time and puts them in relation to other process variables. The core of Scope 3 is a powerful data logger: It offers an outstanding scan rate that can be selected in a range from 100 microseconds to 60 minutes. Thanks to the multi-tasking architecture of the Bachmann automation system, several data series can be logged in parallel and with different scan rates. Interfaces for several application programs increase the functionality of the product.

Database with selective access

The archiving and provision of data are central issues for an automatically operating data recorder. With Scope 3 a database archives all data in the background and offers selective access to it. Archive size and archiving intervals can be set to individual requirements. All data from the online buffer and also from the database is available at the same interface.

Simple analysis of complex interrelationships

A simple click on the data recorder of an Bachmann controller enables data to be displayed immediately and makes it ready for analysis. The configurations can be managed in the work space and the logged data stored in a structured way. Besides frequently used graph functions, such as measuring cursor, zooming, color adaptions, Scope 3 now features important new functions such as curve recalculation, the graphical comparison of logged data or the fast Fourier transform function, directly available for the user. It is also possible for the user to implement his own calculation methods or export formats.

Simplified maintenance and service

In the event of a fault, a connection to the relevant machine or plant often had to be established in order to fetch the relevant data for analysis. In certain cases, work directly on site was then unavoidable. With Scope 3 this is no longer necessary. The occurrence of a fault automatically initiates the logging of the relevant data. Data generated around

this time range can be incorporated easily with the pre-trigger and post-trigger functions. After logging has been completed, a file with all the relevant data of the event is generated on the controller and automatically sent to the service technician by email.

The Bachmann watch list

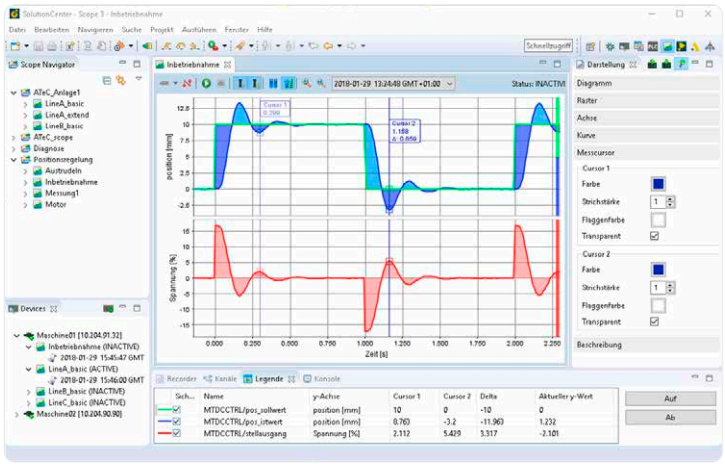
When watching process variables, the user sees the controller as a black box: Defined signals are fed to the inputs and their trace observed at the outputs. If it is possible to read and write variables selectively, this enables conclusions to be drawn about the behavior of the automation system. For efficient work, however, a randomly sorted list of all controller inputs and outputs, as offered by most manufacturers, is not enough. That is why Bachmann offers a freely configurable variable list in the SolutionCenter – a so-called watch list.

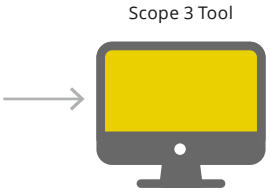
The user defines the content

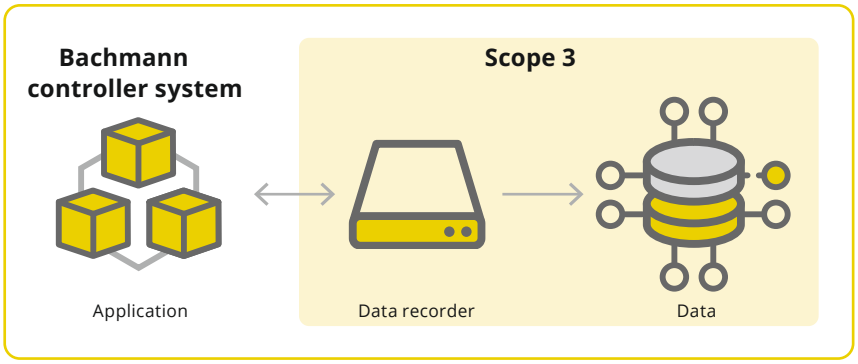
The variable list can be configured quickly by the user – by selecting the variables or channels with drag and drop or in the dialog window with an unlimited number of entered variables. Different filter and sort functions are also provided that simplify the handling of extensive lists. The user can furthermore manually sort the variables and, for example, place the most important ones at the beginning of the list. Variables and channels of different controller systems can be managed in just a single list. In this way, overlapping processes in large machines and plants can be observed and followed.

Integrated setpoint definition

Setpoints for individual parameters can be defined very easily with the help of the watch list. These can be defined with multi-selection in a separate column and downloaded to the controller with just one command. Conversely, actual values from the controller can be entered directly as setpoints in the list. The Bachmann SolutionCenter also shows all the selected variables in a trend diagram. This makes it possible to trace signals over time without any extensive configurations required: for maximum efficiency with maximum certainty.







High precision: The relationships of various process variables over time are analyzed and the exact values read out with the measuring cursor.

Simulation, Process and Control

Model-Based Design

The growing size of energy plants and the use of new technologies are increasing the requirements placed on the automation used. Leading manufacturers are meeting the growing complexity of operational control and the control algorithms required for it with new development techniques. These enable technically mature and highly available plants to be brought out whilst saving development effort at the same time.

BENEFITS

- *Development of open-loop and closed-loop control algorithms with integration in the target hardware directly in MATLAB®/ Simulink®*
- *Simulation modes for the I/O modules used in the application*
- *Automatic code generation and transfer to Bachmann controller without additional parameter setting*
- *Online communication between the Simulink® development environment and the PLC program for parameterization and diagnostics*
- *Integrated interface to automation programs created in conventional programming languages (IEC 61131-3, C/C++)*
- *Integrated interfaces to visualization systems and other PLC systems*
- *Support for hardware-in-the-loop systems with regression tests and environmental simulation*

More on this topic is provided on our website

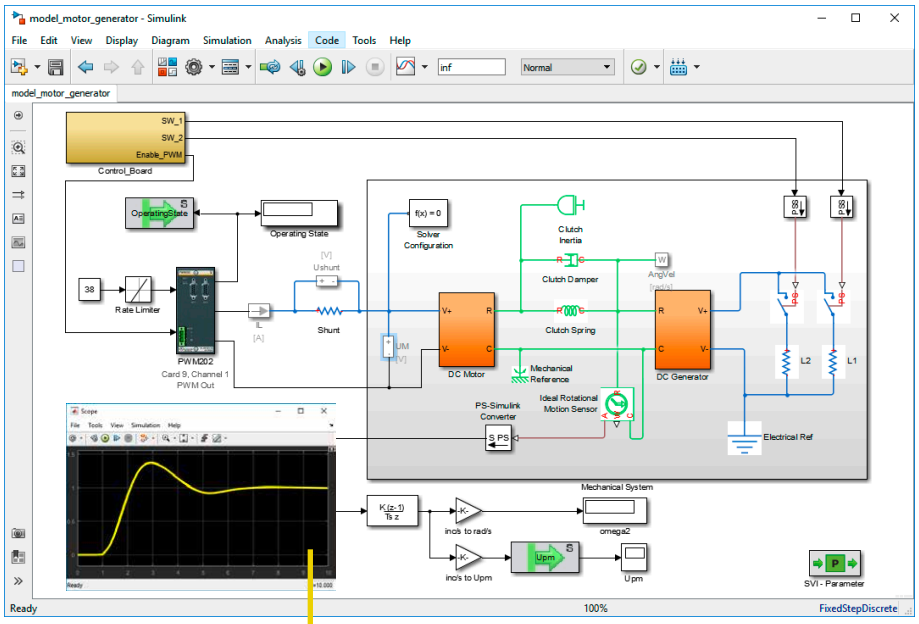
The design of comprehensive energy plants instead of individually isolated subsystems presents engineers with a new set of challenges. Simple analytical calculations provide insufficient information on the behavior of connected systems. One possible solution is an empirical approach, in which the information acquired is used in the solution process. What do you do, however, if a prototype is too expensive or its operation too dangerous?

Simulation

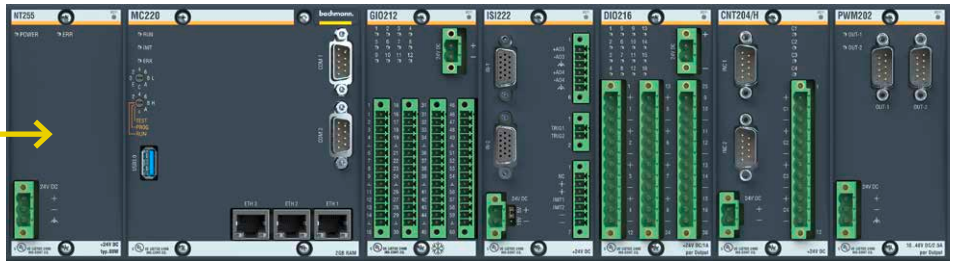
Today's solution is: digital simulation. This enables the engineer to model the behavior of the entire energy plant in the simulation environment of choice. Irrespective of the software used, mathematical interrelationships are ultimately used to describe the response of the system. M-Target for Simulink® enables the simple use of computer-aided simulation, taking the actual automation solution into account. The resulting virtual prototype is simulated as often as required, and both the parameters and environmental conditions derived from the user's design considerations. The viability and design risks of a new plant generation can thus already be drastically reduced during the development phase.

Quality and efficiency

The engineer uses the simulation program not only for modeling plants, but also for designing the sequential and closed-loop control programs required for them. The use of new control concepts available increases the resulting product quality. Furthermore, the optimization algorithms used increase the yield of the energy plant concerned. Solutions that were developed with M-Target for Simulink® come into their own in this discipline. The MATLAB®/Simulink® tool



Simulation: Solution development on the computer model and direct download to the Bachmann controller.



from MathWorks is a well-established software in the market. The program package provides an extensive range of toolboxes and help for creating the simulation model. It also provides interfaces to other domain-specific simulation programs, in which subsystems were already simulated. The functionality of the entire model is then checked and adjusted until the required results are achieved.

Automatic code generation

In line with the model-based development methodology, the Bachmann controller code is then generated directly out of the simulation model. The code is generated with a single click and implemented by M-Target for Simulink® as a separate software module on the controller. Alternatively, M-Target for Simulink® can generate a library for IEC 61131-3 as well as C/C++ directly from the simulation model. This process is fully automated and does not require any subsequent parameter setting on the controller. In this way, any subsequent compilation and configuration errors are excluded from the simulation from the start. The programmed controller is then available for use in a hardware in the loop (HIL) test setup, including regression tests, or can be operated directly in conjunction with the actual plant.

Cost optimized

The ability to also equip complex plants with advanced automation quickly offsets the inexpensive initial investment required. A transparent license model that does not require any quantity-based runtime licenses also simplifies the pricing of a completed wind turbine. M-Target for Simulink® thus makes an essential contribution to the aim of "bringing better goods to the market faster".

Communication in any Language

Efficient energy park networking

When different energy generators, such as from wind, PV, CHP and energy storage systems, as well as consumers are integrated in existing grids, the greatest challenge in implementing the project is the communication between systems. Communicative controller systems and standard protocols are first choice here.

BENEFITS

- *Free choice of protocol without changing the automation*
- *Only one contact for automation and communication*
- *Always the required protocol available*
- *Ability to react flexibly and separate tasks*
- *Concentrating on the essentials: the core expertise*
- *No stock-keeping of additional devices*
- *Greater availability thanks to fewer devices used*

More on this topic is provided on our website

Perfectly served with Bachmann

The Bachmann controller system provides all the international telecontrol protocols required for energy technology as a software solution for straightforward and effortless installation. Additional hardware or modifications to the operational control program are unnecessary. This enables the requirements of the customer to be implemented quickly and inexpensively. The Bachmann controller is a genuine multi-talent here: It can control external devices as a master and at the same time be incorporated in a higher-level control system. Different protocols can also be operated on the same controller.

Preventing consequential damage

The constantly growing use of renewable energy sources in the grid is also increasing requirements with regard to communication: A continuous data exchange must be reliably guaranteed at all times – always in compliance with the relevant regulations and standards.

Application development in all languages

The SolutionCenter and Bachmann controller support a wide range of programming languages for example IEC 61131-3, C/C++ as well as MATLAB®/Simulink®.

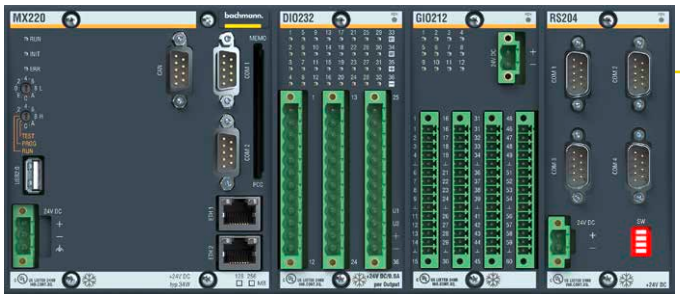
Fieldbus communication

The openness of the overall system makes it possible to integrate third-party systems and components without any problems. The latest fieldbuses and telecontrol protocols are available for this.

PROFINET · PROFIBUS · sercos the automation bus · DeviceNet · Modbus · FASTBUS · CANopen · EtherCAT

PowerPlant Network

The direct integration of the modules for grid measurement in the Bachmann automation system enables fast and reliable measurement, monitoring and synchronization of the essential grid values.



Grid

Combined heat and power unit

Wind farm

Biogas plant

Solar farm

Transformer station

Hydroelectric power plant

Designing State-of-the-Art Visualizations Easily

The world of visualization

The triumphant entry of smartphones and tablet PCs also in the industrial sector in recent years has led to considerably more requirements being placed on visualizations. This development has given manufacturers the opportunity to stand out from the competition with innovative operating concepts. Bachmann offers a complete product portfolio for a wide range of requirements in this area, from local machine visualizations, to SCADA systems for plants, right through to private cloud solutions.

BENEFITS

- *The complete hardware and software solution considerably reduces the effort required for integration and testing*
- *Maximum flexibility and openness ensure rapid implementation, good maintainability and the possibility to expand the installation efficiently*
- *Complete user/group/rights concept incl. user-dependent language selection*
- *User interfaces in pure web technology*

More on this topic is provided on our website

The right solution for any application

The increasing networking of machines and plants arising from the onset of Industry 4.0 also opens up new possibilities in the field of visualization. More machine data can be extracted at several levels in order to maintain transparency and obtain new information.

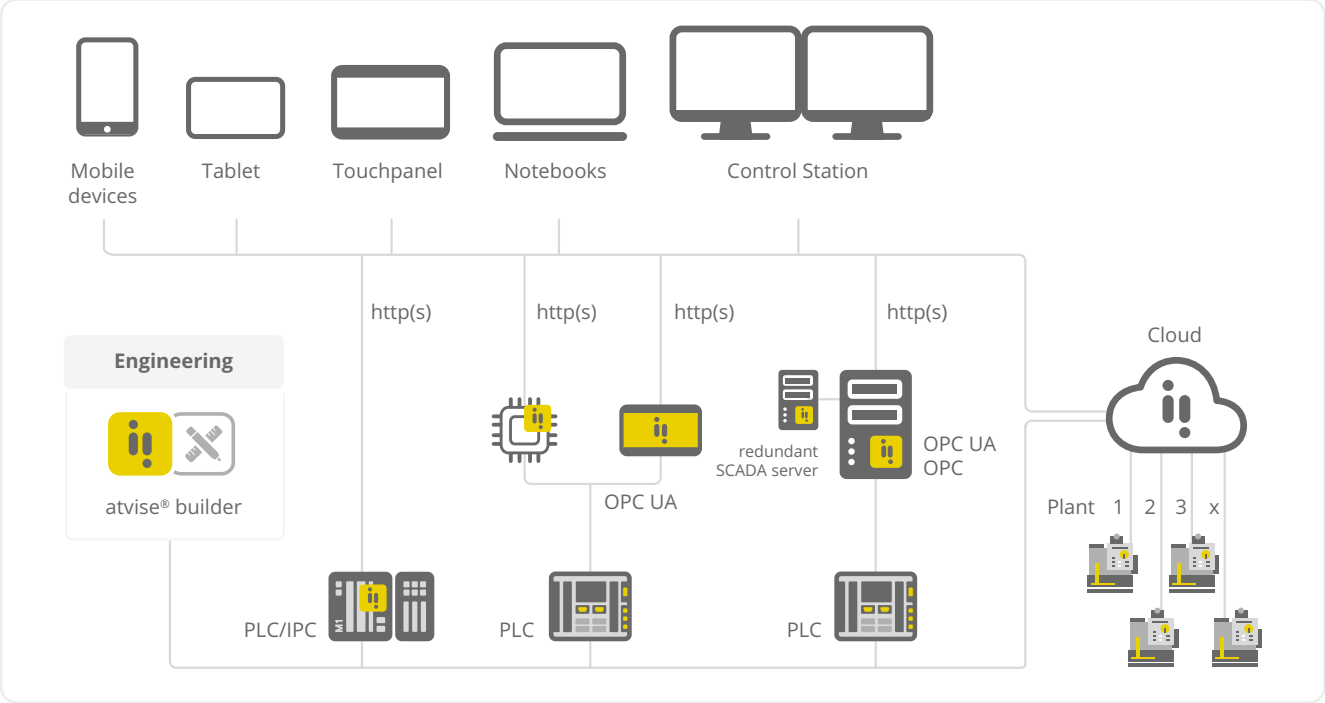
Bachmann's complete hardware and software solutions offer maximum flexibility and openness to ensure rapid implementation, easy maintenance and efficient expandability. The software solution is created from standard web technologies that are efficiently linked to data by drag and drop using a shared engineering tool. The hardware consists of a modular system made up of components that enable tailored solutions to be created quickly.

Machine visualizations

The server with Bachmann automation is directly integrated in the Bachmann controller for local machine operation. The visualizations are displayed on the dedicated web panels of the OT1200 product series. Ready-to-use templates are available for other typical visualization tasks, such as alarming and the graphical display of trends or high-resolution Scope3 data. The visualization can also be activated for other terminal devices via http(s).

Plant visualization

atvise® scada enables the data of several controllers to be combined easily via the popular OPC UA standard. In this way, objects and types can be mapped to each other automatically. This architecture is suitable for the visualization of machines and plants, right through to entire control centers. The pow-



The Bachmann HMI product portfolio offers the right solution for any application in the highest quality and can be tailored to your specific requirements as needed.

erful panel PCs of the OT1300 series are used here both as an atvise® scada server and as a display device at the same time.

Visualization in the cloud

Information is one of our most valuable resources. Data has to be refined in order to optimize processes. The private cloud is the answer to sustainable data usage: The atvise® portal private cloud solution enables you to increase the efficiency of your remote monitoring applications – simply through the use of existing atvise® visualizations with just a single click. Important information is provided for the target groups specified, at the right time and place. A buffer mechanism guarantees the continuous transmission of real operating data, even if the network connections are unstable. Commands and alarm acknowledgements can also be sent back to machines in the field via an encrypted connection and the appropriate authorization.

Efficient engineering

The engineering for all three levels, from the machine, to the plant, right through to the cloud, is carried out in the same development environment. Many typical tasks can be implemented quickly with ready-to-use components and templates. Additional options and variants for machines and plants can be created with dynamic configurations in a single visualization project. The use of standard web technologies also makes it possible to seamlessly integrate the web services of third party providers.

The complete solution in view

The operator terminals have also been optimized for web visualizations, in line with the web-based software solution. The required browser, including an intelligent onscreen keypad, is already preinstalled and can be set up in a few steps to ensure rapid commissioning. The brilliant displays offer very good viewing angles, a bright image and strong colors to ensure the high quality presentation of the visualization. The trend toward widescreen diagonals and attractive multi-touch glass screens continues, and enables additional operating concepts that are already well established in the consumer sector.

For Bachmann, the world of visualization means having a perfectly matched portfolio for the visualization of web technologies from the machine right through to the cloud.

Save Time and Resources

CHP Template: Reduce engineering effort by up to 80 %

We deliver a Combined Heat and Power (CHP) Template specially tailored to the developers and manufacturers of CHP units.

The CHP Template offers solutions for the tasks most frequently required to operate a CHP unit. This includes all the relevant functions for dynamic and static grid support according to the VDE-AR-N 4105 Low-Voltage Directive and the VDE-AR-N 4110 Medium-Voltage Directive. The CHP Template saves up to 80 % in engineering time and costs.

Implement new requirements quickly

CHP unit manufacturers often need to implement new requirements, either by choice or through regulation. These can include, for example, the creation of virtual power stations or the implementation of grid connection in accordance with directives. Such tasks require a controller with more freedom than the compact PLCs often found in CHP units, and conversion efforts can be considerable. Bachmann has designed the CHP Template to reduce these efforts.

Integrate directly with certified Bachmann hardware

As well as tasks related to every aspect of grid connection, such as generator and grid monitoring, grid measurement and synchronization, typical close-loop control tasks are also solved. Speed, power, phase frequency and voltage regulation as well as the regulation of the mixture or engine cooling circuit are included. The template, provided as a ready-to-use Codesys project in Structured Text, offers an extensive range of functions. The CHP Template provides these and other functions as preprogrammed modules. The GSP274 hardware, part of the CHP Template, also meets the requirements of VDE-AR-N 4105 and VDE-AR-N 4110 for generating plants on the low-voltage and medium voltage grid. Compliance is verified with the appropriate certificates.

Know-how is protected

Each function can be modified or extended by the programmer as required. Development tools remain with the CHP unit manufacturer and are not required for operation, whilst access to operating parameters and status displays can be controlled with an access rights system. The CHP Template therefore provides a highly effective basis for the engineering of a combined heat and power unit. However, it also provides the freedom to implement manufacturer-specific extensions, whereby expertise is protected at all times.

Web visualization

A web visualization is also provided for efficient testing and commissioning. Visualization of the CHP unit can be adapted to customer requirements, enabling the CHP unit manufacturer to offer a unique product both graphically and functionally.

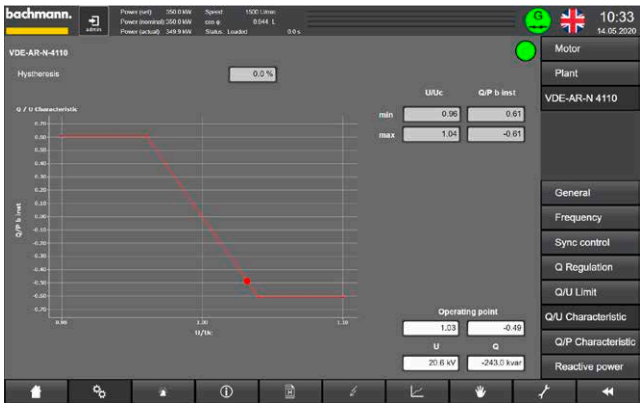
More on this topic is provided on our website

Contents and functions

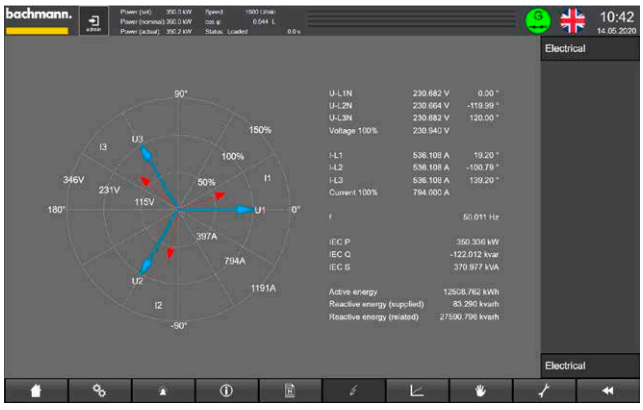
- Motor control (starting, stopping, monitoring, etc.)
- Generator monitoring
- Grid monitoring acc. to VDE-AR-N 4105 and 4110
- Grid measuring with integrated GSP functions
- Generator-grid synchronization
- Speed measuring, speed control
- Power control, phase-frequency control
- Voltage control, power factor control
- Mixture control/exhaust gas (lambda/pressure) with and without turbo charger
- Reverse power protection
- Derating
- Engine cooling circuit, heating circuit, charge air cooling circuit
- Processing of anti-knock signals
- Emergency cooling circuit control
- Exhaust heat exchanger, room air cooling circuit control
- Control for throttle flap and gas air mixer (optionally also with stepper motors)
- Statistics recording such as operating hours, start counter, maintenance interval
- Alarm management/history, traffic light indication, data logger
- Saving machine parameters and loading in csv format
- Web visualization with user management

Separate program task for directive functions such as

- Static grid support (protection functions of the GSP274 with component certificate)
- Dynamic grid support/HVRT/LVRT/ 2-pole and 3-pole
- Q/U characteristic
- Q/P characteristic
- Q/U voltage limitation function
- Power factor CosPhi
- Cut-in conditions/active power gradients
- Active power adjustment with over frequency and under frequency (50.2 Hz characteristic)
- Grid safety management in accordance with VDE-AR-N 4110
- Graphical display of characteristics with support point tables and operating point display
- Reactive power in accordance with PT1 behavior (VDE-AR-N 4110)
- Grid and system protection in accordance with VDE-AR-N 4105
- Power factor control through:
  – Setpoint CosPhi
  – Analog
  – Setpoint Q
  – Characteristics
  – Telecontrol protocols
- Output setting through:
  – Binary inputs
  – Analog input
  – Setpoint P
  – Telecontrol protocols



Q/U characteristic



Vector diagram of currents and voltages

Solutions for Energy Supply

Power management

The widespread use of electricity in all aspects of work and life offers a multitude of benefits, greater convenience and an improved quality of life. In order to ensure energy-optimized solutions in production, in buildings and in infrastructures, there is a growing need for these to be based on suitable measuring systems. Bachmann offers both synergies through the direct integration in the PLC world as well as certified compliance with the latest regulations.

Modules for grid measurement

The energy efficiency of machines and plants has significantly increased in importance. This requires devices for operational measurement at individual machines just as much as the overall total measurement of consumption at an entire site (energy monitoring). At the same time, supply security must also be ensured at all network levels even when conditions are continually more difficult. So-called grid codes have been defined by grid operators because of the mutual interaction that occurs between energy generating units and the electrical supply grid. These grid codes stipulate the required behavior of generating units and also major consumers in the event of different grid situations or faults.

Bachmann grid measuring modules accurately measure all relevant grid variables and provide the necessary monitoring/protection functions in order to adhere precisely and simply to the specified grid codes. The GSP274 module series also makes it possible to implement directly the actual synchronization of generating units with the supply grid.

Simple scaling and integration

Implemented as standard modules in the modular Bachmann automation system, they enable the simple scaling and integration of other measured variables via signal or fieldbus interfaces. Several telecontrol protocols, OPC, email and FTP are provided for routing the data to higher-level systems. The standard configuration and diagnostics in the SolutionCenter engineering tool supports commissioning and teleservice tasks.

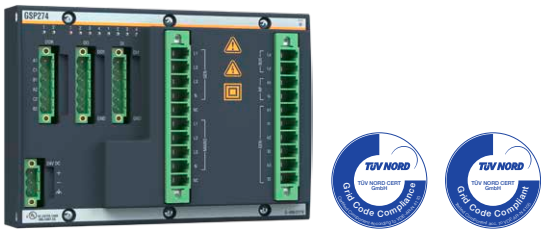
GM260: GRID MEASUREMENT

- *Compact design for 2 three-phase branches*
- *Measurement of current, voltage, frequency, power, power factor, phase angle*
- *2 independent 4Q energy counters (active and reactive power, drawn/supplied)*
- *Accuracy V: 0.2 %, I: 0.3 %, P,Q: 0.5 %*
- *TrueRMS calculation online*
- *Rated voltages up to 480 V directly connectable, 1A standard CT*
- *Cert.: CE, UL, DNV-GL, ABS, LR, BV*

Application areas	GM260	GMP232/x	GSP274
Operational measurement	✔	✔	✔
Energy monitoring	✔	✔	✔
Power quality	–	✔	✔
Monitoring/grid connection	–	✔	✔
Protection function	–	✔	✔
Online fault diagnostics	–	✔	✔
Generator connection (synchronization)	–	–	✔

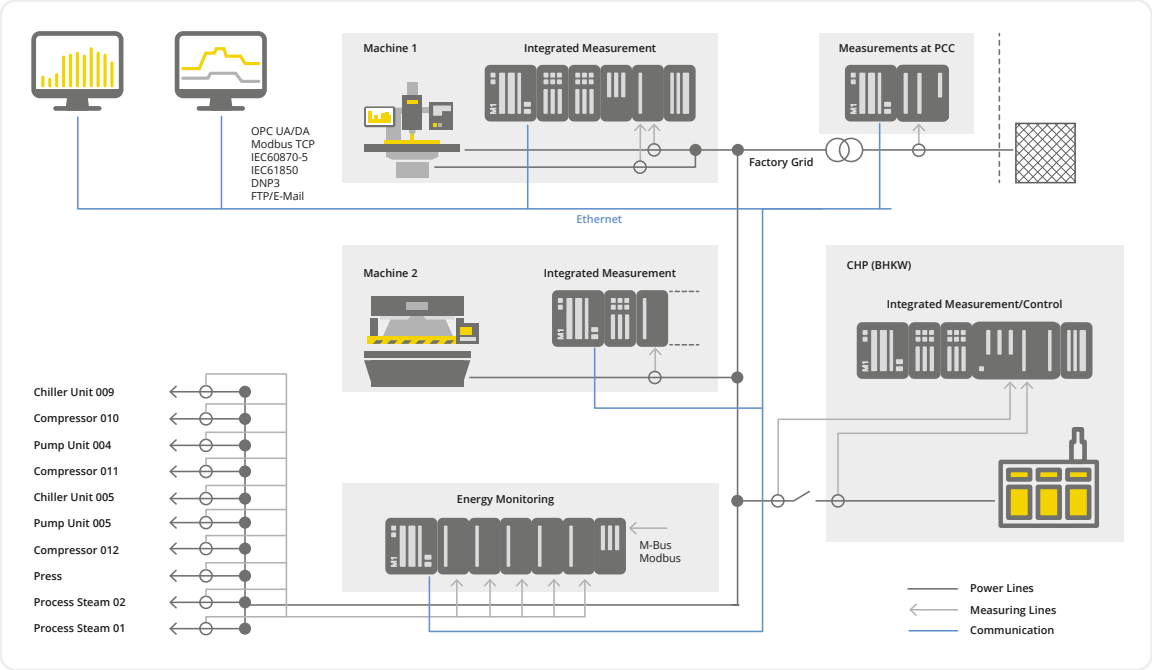
GMP232/X: GRID MEASUREMENT AND PROTECTION

- *Highly accurate measurement of current, voltage, frequency, power, power factor, phase angle*
- *Separate 4Q energy counters for TRMS and fundamental*
- *Rated voltages up to 690 V directly connectable, 1A/5A CTs*
- *Accuracy V: 0.1 %, I: 0.1 %, P,Q: 0.2 %, f: 1 mHz*
- *Measurement of grid harmonics up to the 50th as individual amplitudes, THD, TDD (power quality)*
- *Monitoring functions for grid and generator protection including:*
  – Overshoot/undershoot of V, f
  – Rate of change of frequency
  – Maximum power, reverse power
  – Asymmetry, vector jump
  – Fault Ride Through (LVRT/FRT)
  – Voltage dependent reactive power protection (Q(U))
- *Direct relay outputs for circuit-breaker/trip circuits*
- *Integrated real-time data recorder*
- *Integrated event logging*
- *Automated data aggregation (MEAN, MIN, MAX)*
- *Measured value simulation*
- *Cert.: CE, UL, BDEW (TR3, TR8), ENA ER G59/3, IEEE C37.90,...*



GSP274: GRID SYNCHRONIZATION AND PROTECTION

- *Measurement of current, voltage, frequency, power, power factor, phase angle*
- *4Q energy counter*
- *7 voltage, 4 current inputs*
- *Synchronization monitoring*
- *Rated voltages up to 480 V directly connectable, 5A standard CTs*
- *Accuracy V: 0.1 %, I: 0.1 %*
- *Measurement of grid harmonics up to the 50th as individual amplitudes, THD, TDD (power quality)*
- *Monitoring functions for grid and generator protection including:*
  – Overshoot/undershoot of V, I, f
  – Rate of change of frequency
  – Asymmetry, vector jump
  – Fault Ride Through (LVRT)
  – Voltage dependent reactive power protection (Q(U))
- *4 direct outputs for circuit-breakers/trip circuits and 2 relays for grid and system protection*
- *Integrated real-time data recorder*
- *Integrated event logging*
- *Measured value simulation*
- *Cert.: CE, UL, BDEW, VDE AR4105, G59/3, IEEE C37.90,...*



Grid and system protection

A range of 40 configurable monitoring functions enable the required combination of grid and plant protection to be set up easily. All the protection functions required by standard grid codes are provided. This ranges from multi-stage time independent voltage and frequency protection to Q(U), right through to phase shift monitoring. Time-dependent functions for LVRT and HVRT (low-/high-voltage-ride-through) for dynamic grid support can also be configured easily via configuration points.

The modules of the GMP232/x series have been extensively tested by TÜV Nord (German Technical Supervisory Association) and have valid component certificates (grid code compliant) in accordance with international standards: BDEW guideline, FGW TR 3 & TR 8, ENA ER G59/3, IEEE C37.90.

Fault diagnostics

The time sequence data can be recorded at a resolution of up to 100 µs, either manually or when a protection function trips. The adjustable pre-trigger thus also enables the time leading up to the fault to be recorded. The fault recording can be saved in the SolutionCenter or directly by the application program in the established Comtrade format (IEEE Std. C37.111) or passed on. Each protection event is recorded in the internal event memory, together with all time stamps, which can be synchronized externally.

Plant integration with synergy

The Bachmann energy modules guarantee the reliable and fast measuring of all essential grid variables for a wide range of applications. From operational measurement directly in the generating unit to the monitoring of entire distribution panels, right through to higher-level power quality monitoring, system protection or the synchronization of generator plants. The I/O interfaces of the Bachmann controller system offer an ideal addition to the measuring units, and communication protocols, such as IEC 61850, IEC 60870, DNP3, OPC or Modbus, are available for routing data to higher-level systems.

PLC integration

Bachmann's grid measurement modules comply with the design of the signal modules of the Bachmann controller system. When mounted in main stations or substations of the modular PLC system, they supply the key characteristic values of the measured three-phase systems already as channel values. The configuration of communication elements or setting of fieldbus parameters becomes unnecessary. Values recorded from a highly dynamic process are provided in the user program without any delay caused by asynchronous bus cycles. Especially time-critical or safety-critical functions, such as protective tripping in the event of limit violations, are processed by the modules completely autonomously. The grid module can also be spatially separated from the PLC

BENEFITS

- *High-performance data connection via backplane bus*
- *Minimum delay/high dynamics*
- *Cyclic request or grid event-based updating (events)*
- *Correlation of various grid variables, correlation of different operating values*
- *Controller CPU permits additional calculations and combinatorics (based on provided calculation values or sampled data)*
- *Configuration management together with the Bachmann automation system*
- *Monitoring/data display via SolutionCenter, local visualizations (webMI) or SCADA via telecontrol protocols and fieldbuses*
- *Security and remote maintenance via Bachmann automation system*

More on this topic is provided on our website

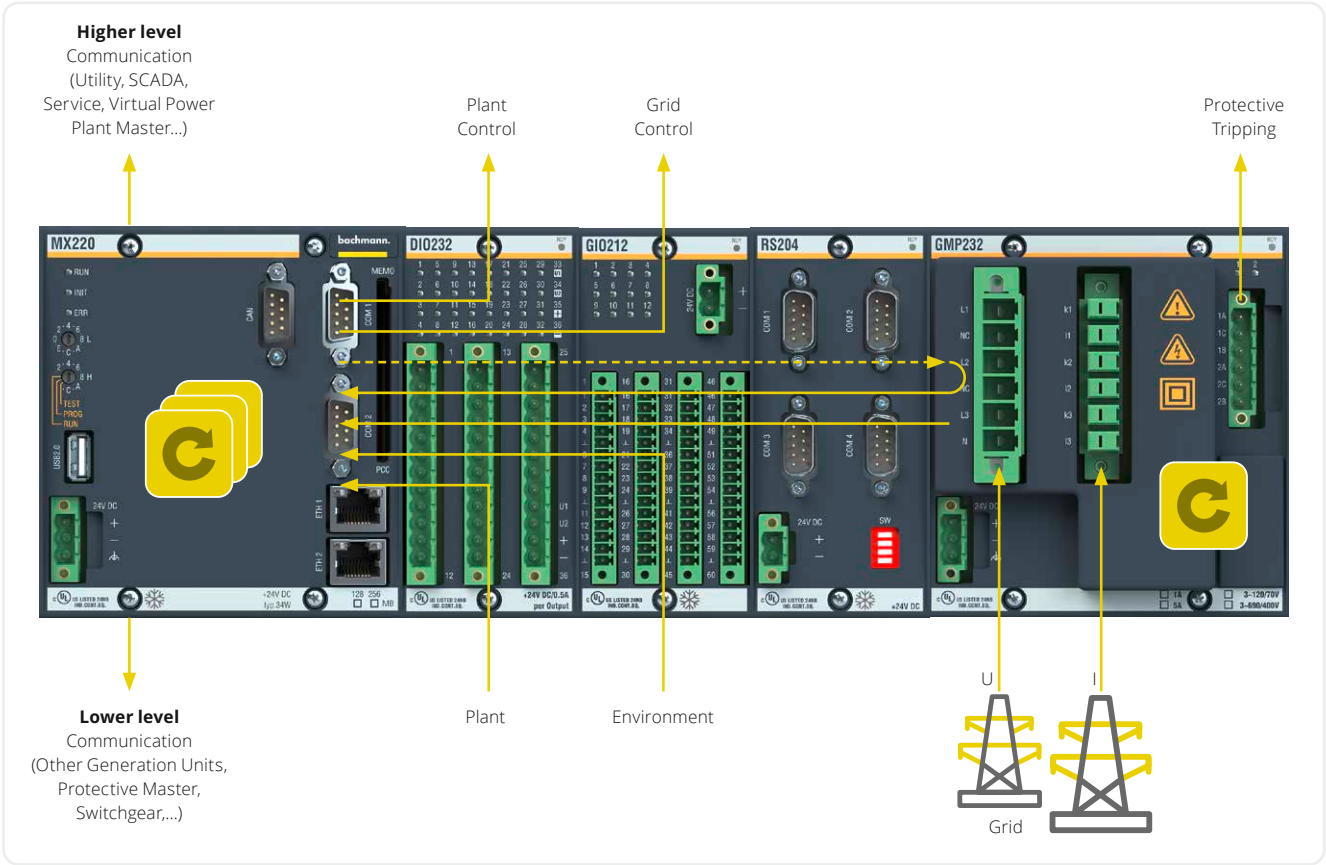
if it is mounted on an electrically isolated substation connected via fiber optic cables. Insights gained from measured values or the status of the operational management can be incorporated into the energy tasks at any time, and vice versa. These correlations firstly allow the particularly low-stress operation of the plant, whilst also providing the basis for indirectly determining operating conditions and faults (for example, a change in power consumption in the particular operating state can indicate faults in heating circuits).

No separate signal lines or tools are required for monitoring and remote maintenance. By being integrated in the security concept and rights system, access to the grid modules and their data management are also controlled.

Configuration and display

Grid modules from Bachmann are fully integrated into the SolutionCenter. Configurations can be created efficiently and saved for reuse at a later time. An automated comparison of limit values set online with saved configuration files makes it easier to locate changes. The user interface shows both the recorded channel values and the derived (calculated) variables. Development, commissioning and fault analysis are simplified with tabular, vector and time sequence displays.

It is also possible to configure all measured and calculation values of the monitored three-phase grids as graphic displays in a dynamic web interface (webMI). The actual sequence of protection events (sequence of events) can be viewed in the event log of the protective devices. Thanks to globally synchronization time bases (SNTP, IEEE 1588 PTP), the event sequence can also be reconstructed from remote stations. The modules of the GMP and GSP families offer a high-performance data recorder that can be directly integrated. If a protection event occurs (or if called in the PLC user program), high-resolution time series of selected grid values are also logged. The time leading up to the triggering event can also be logged using the pretrigger function. The data can be exported and transmitted in CSV or Comtrade format (IEEE Std. C37.111). Power quality values, such as harmonic spectrum or various distortion factors, can be displayed immediately in the SolutionCenter without the need for any programming, or read via the application program.



Safety without Compromise

Safety Control

Modern safety solutions using a programmable safety controller make it possible to implement functions that go far beyond the conventional emergency-stop chain. Bachmann offers a complete safety package that is successfully used in a wide range of different applications under the toughest conditions.

In modern machine and plant building, the protection of personnel and systems is regulated by the new Machinery Directive. This directive and the associated safety standards stipulate the use of the latest methods and measures in the implementation of safety devices in order to ensure the optimum protection of people and goods. In addition to this, each safety component is developed and tested under the supervision of a certification body. Operators of energy plants not only benefit from the increased personal protection provided but also benefit financially. Critical signals can already be acquired and evaluated using several sensors. An approved component such Bachmann's SLC284 safety processor module, combined with the integrated testing and monitoring functions, eliminates the need for multiple acquisition whilst keeping life cycle costs low at the same time.

Safety engineering under control

The safety components from Bachmann are ideally equipped for use in energy plants. Operational control, safety engineering and operating devices are perfectly matched and offer open communication. The fastest possible response times, intuitive operation and comprehensive diagnostic options guarantee the highest possible level of safety. All Bachmann safety modules are certified with the highest safety category SIL3 and PL3 for machines and systems. The safety modules can be arranged within the plant control system as required, thus enabling the implementation of individually tailored solutions. Safety channels that are not required can be used as standard digital I/Os without any restrictions.

Safety relays can be replaced thanks to the 2A outputs of the remote SDO204 output module. This saves space, wiring effort and additional costs. With the integration of the Safety Developer in the SolutionCenter engineering tool, Bachmann makes safety programming easy for the user on the basis of established standards such as IEC 61131-3 and PLCopen Safety. All the safety modules of Bachmann, together with the necessary programming tools and function blocks, have all been certified according to the relevant standards by the TÜV Süd certification body. UL508 approval also ensures safety when operating in North America. All modules are available as coldclimate versions. Safety is thus also guaranteed in extreme environmental conditions.

Benefits for manufacturer and operator

Programmable safety engineering makes practical implementation and daily use easy. It enables the secure monitoring of all the internal states of an installation during operation, including the safety circuits, also via teleservice functions. Bachmann offers you tailored solutions based on the experience gathered from thousands of successfully used control components in energy plants all over the world.

SAFETY STANDARDS AND REGULATIONS

- *IEC 60945*
- *IEC 61508*
- *ISO 13849*
- *IEC 62061*
- *EN 61511*

More on this topic is provided on our website

Knowing that Plants and Data are Secure

Security

Modern business models for plant manufacturers require access to controller networks and control consoles via Intranet and via the Internet. Without the use of suitable mechanisms, the expanding network increases the possibility of plants being accessed without authorization. The unauthorized manipulation of processes here canresult in serious damage. Furthermore, the complete logging of interventions is now even a statutory requirement in some sectors. Protection from unauthorized access and the targeted assignment of rights are therefore a top priority when networking plants.

THE BACHMANN SOLUTION: MANIPULATION PROTECTION

- *Integration of security functions into the basic functionality*
- *Protection from unauthorized manipulation with a 5-level concept*
- *Simple configuration and adaption*
- *Convenient user and password management*
- *Precise access logging, regression tests and environmental simulation*

More on this topic is provided on our website

The direct result of targeted malicious access to a machine controller or an unknown operating error are the same: downtime or even destruction of a machine or plant and therefore production outage, loss of reputation and money. Ensuring robust protection against faults is therefore an essential priority. Data and communication protection as well as the logging of accesses are preventative measures that make unauthorized access difficult and highlight any abnormalities.

Targeted access

Exposed machinery and plants do not have the same perimeter protection as enclosed manufacturing plants. Microgrids, energy storage systems, wind turbines or biogas plants are thus relatively easy to access, and the response times in the event of a detected security breach are high. The high risk to production plants mainly arises from the authorized personnel. The service personnel of external service providers or a dismissed employee who is intent on causing willful damage are two classical examples. At risk here are switches, routers and controllers with free ports. These can be used to cause faults unnoticed or for the targeted interception of communication. Bachmann controller components provide a range of measures to counter targeted access.

Security as standard

An effective security management system not only helps with unwanted and potentially destructive hacker attacks. Particularly in the protected environment of production plants, any accidental modification of machine parameters or configuration errors in the machine network are difficult to fully exclude. The effect of these, however, is often as serious as outside threats. Bachmann protects plants from production failure caused by unauthorized manipulation with a 5-level security concept. The entire Bachmann CPU product range comes with all security functions as standard. This therefore provides the user with an optimized ready-to-use security package.

Level 1: Protected network

- Tap-proof data transmission through encrypted network connections
- Band width limitation to defend against overload attacks and for protection from faults in the network periphery

Level 2: Tap-proof communication

- Access control based on integrated user and password management
- Server and client authentication for the protection of automated teleservice accesses
- Secure end-to-end encryption to the latest state of the art (TLS 1.2)

Level 3: Authorized access control

- Rights are examined irrespective of the access path to the controller (visualization, SolutionCenter or with OPC UA)
- Restriction of system and execution rights for every user
- Role-based access control with groups (users inherit group rights)
- Configuration of access protection and visibility of files and process variables
- Protocol support for certificate management (SCEP), authorization (LDAP) and logging (syslog)

Level 4: Hardened operating system

- The saving and running of additional applications can be prohibited
- Memory protection measures so that third-party processes cannot access the memory of the application
- Detailed logging of all user accesses with all user data and partition encryption

Level 5: Secure user applications

- Open interfaces to adapt and enhance all access control functions and for the use of cryptographic functions in applications
- Backup and recovery mechanisms
- Predefined security levels as templates for simple configuration

Long-Term Availability in Energy Technology

Saving resources

Energy plants are usually in operation for decades, so that the automation systems have to be available for a very long time as well. Long-term availability in this context refers firstly to the long service life of the components and secondly, the possibility to easily replace hardware modules or make system enhancements to hardware and software even after 15 or 20 years.

Ensuring the availability of machinery and plants is always the key objective here. For this the automation components must be able to run continuously in failsafe operation. This requires AAA quality and a proven high level of reliability. If a device replacement is nevertheless required, the controllers must be 100 % compatible both mechanically as well as functionally. Functional compatibility is important so that no software adaptions are required when a module is replaced. The controller must be mechanically compatible so that the new device can be replaced and connected 1:1 in the existing system.

Quality standards

Highest quality standards in product development and manufacturing are the foundation of long lasting automation components. At Bachmann, a quality assurance system to ISO 9001 has already been in place since 1996. The development standard based on the V model, in which each development phase has a corresponding test phase, has already been in place at the company for 15 years. The detailed and complete documentation of all processes in development and production gives Bachmann still today easy access to articles over 20 years old, so that they can be produced as repair spares according to the same standards and processes as for the latest products.

Bachmann designs and manufactures its test equipment itself. The in-house development of test equipment ensures that testing and measurement processes meet the latest technological and normative standards. It also makes it possible, when necessary, to test older equipment required as replacements for repairs.

Intelligent component management

A module is only as good as the components it consists of. That's why Bachmann only relies on high quality components from reputable suppliers. All incoming components also have to meet a host of other criteria as well as providing the basic function. In an extensive process, a team of experts examine components in terms of supply security, quality, failure probability, price, identification, packaging, approvals and naturally correct operation. Their processing by the manufacturing department is inspected and the development department carries out function tests up to the limit of the load tolerance. Incoming goods tests are then defined and audits are carried out with manufacturers and suppliers if required. Only when the result reports do not show any objection to the use of the components does the automation specialist release them in the article master data for the defined applications.

Through intelligent supplier management, Bachmann ensures the long-term availability of each individual component by using only reliable manufacturers and robust technologies as well as running a second source strategy. All components are also monitored in a database in relation to their life cycle, which can lead to warnings like "do not use for new developments" right through to the active replacement through redesign. Bachmann thus ensures that all required components, even after 15 or 20 years, are available to make replacement equipment.

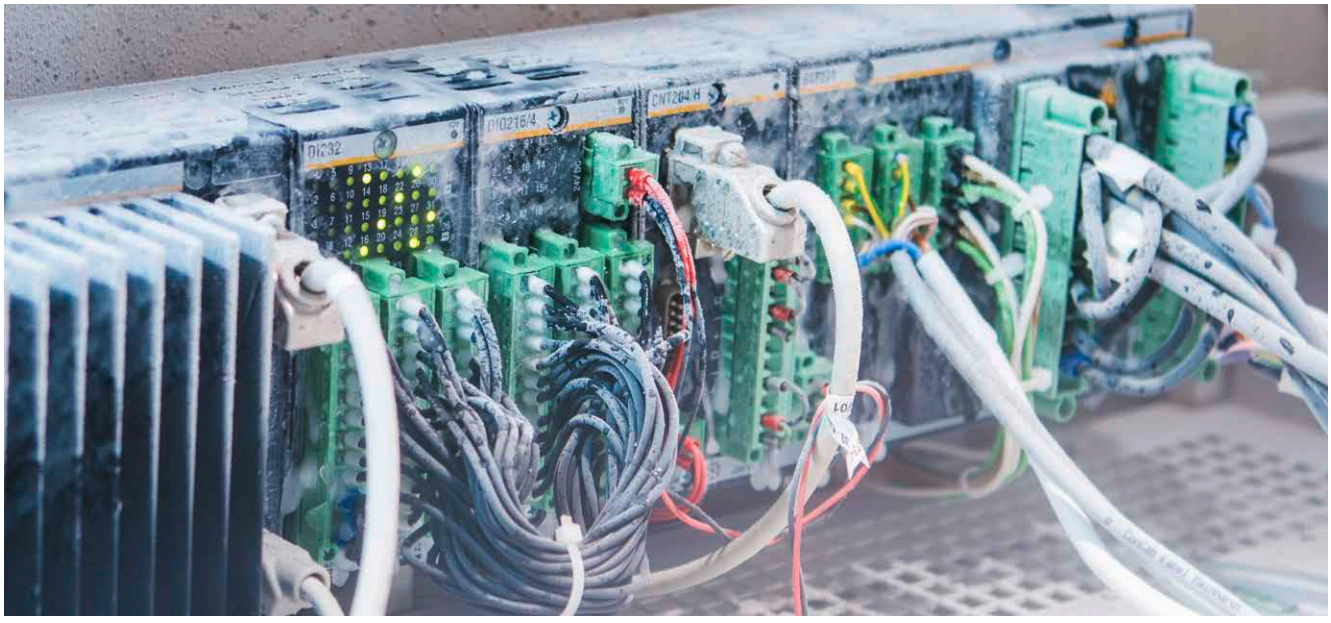
ColdClimate
-40 to 70 °C

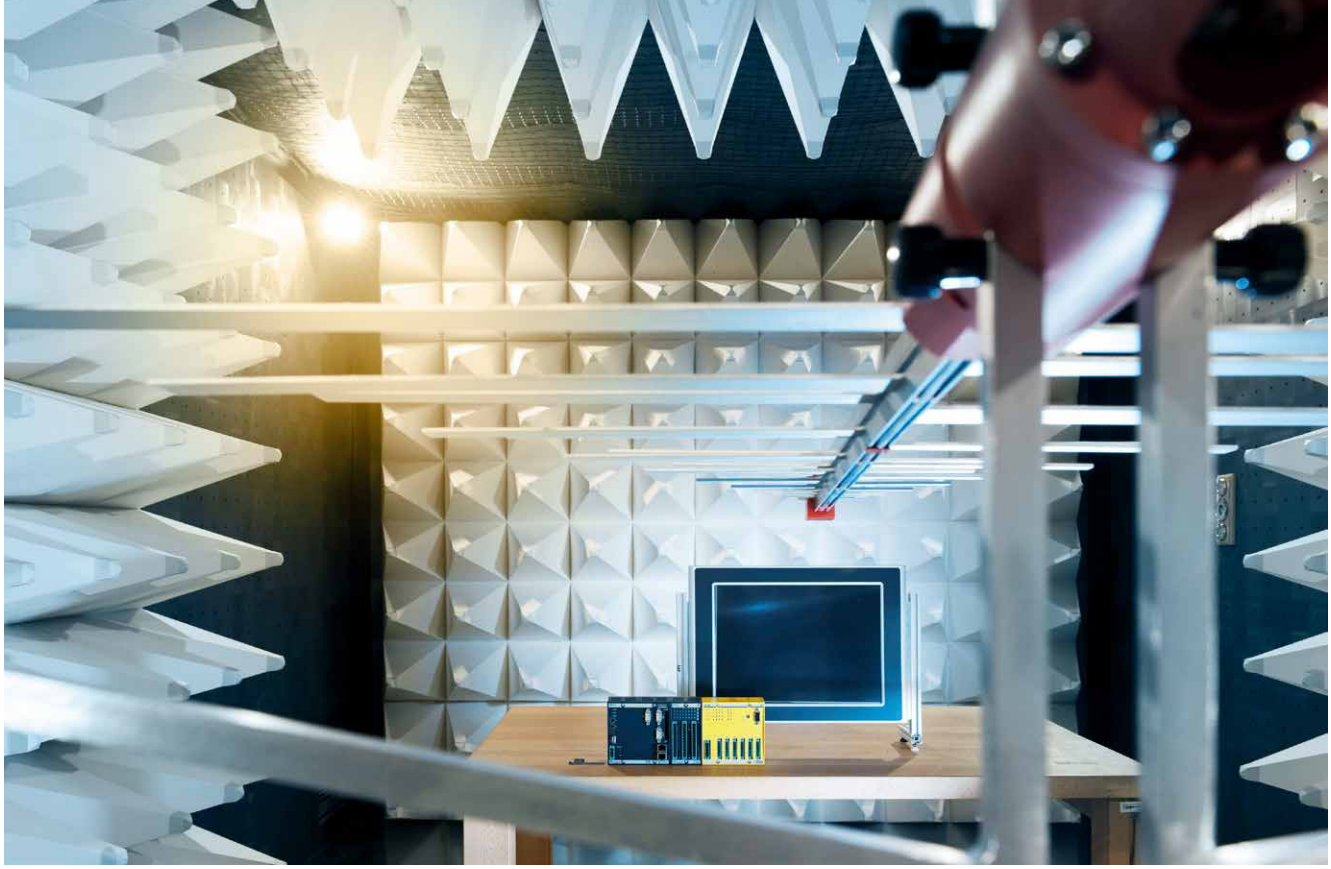
Climatic test

In the development phase, a wide range of different internal specification tests are performed in accordance with the standards and requirements of certification bodies. These include climatic tests according to the European standard EN/IEC 61131-2, which lays down the equipment requirements and tests for programmable controllers. All automation components at Bachmann also undergo temperature change tests according to EN/IEC 60068-2-14 (test Nb). The highly accelerated life test (HALT) climatic and stress test subjects the test objects to conditions that are more severe than in an Arctic climate. The HALT test exposes an electronic module for release to a climatic change test under full load and in excess of the normal operating temperature limits (from -60 to +90 °C).

The functional limits in the temperature range are tested first of all, i. e. the temperature range is continually extended at full load beyond the upper and lower limits in cycles until the device ceases to function. In the second test, the controller is subjected to vibration in all six directions across a broad frequency range and at increasing intensity every cycle until it fails. The shocks range up to 25 times the gravitational acceleration. In the third step, an identical module is exposed to the combined temperature and vibration limits at which the modules previously still functioned, until failures also occur in this combination. In these extreme conditions the test objects are effectively aged and damaged in order to determine any electrical and mechanical weaknesses early on. In this way Bachmann tests the electrical function of the device and its reserves, the component dimensioning as well as the electromechanical design, such as solder points and connectors. Only in this way is it possible to detect and rectify damage already in the development phase that would otherwise only appear during operation 15 to 20 years later.

▼ Iced up controller during a HALT test.





EMC test laboratory

Interference immunity thanks to in-house EMC laboratory

Automation products in the EU are required to observe the guidelines for electromagnetic compatibility. However, the measurement of electromagnetic compatibility (EMC) presents a particular challenge since the results cannot be predicted or simulated in every case. Bachmann has therefore set up its own EMC test laboratory, in which all the standard tests for interference immunity, such a electrostatic discharge (ESD), burst (interference from high frequency switch operations) and surge (high energy pulses caused by switching large currents) can be carried out. The standard here is set by Bachmann's own stringent EMC guidelines, which provide a large safety margin over and above the requirements of the general standard. The Bachmann EMC test bay can test emitted interference in a frequency range from 30 MHz to 3 GHz. Thanks to its advanced multiple shielding through shield plates, ferrite tiles and specially coated polystyrene pyramids, the chamber is designed for a frequency range from 1 MHz to 18 GHz. This makes it easy for Bachmann to test improvements to devices directly in terms of their EMC and implement them quickly.

Before production release

The following function tests include component tests, in which all modules are tested for features such as functionality, accuracy, response to faults, diagnostics, robust design, maintenance ability, usability and efficiency. System tests then test the specifications of the devices in the networked automation system. Only in this way is it possible to test the interaction with other modules or the effects of particular constellations. Individual acceptance tests are also carried out by the appropriate customer advisor for complex applications involving custom developments and new developments. The production release for a new automation component is only issued when all the tests described have been successfully completed.

Quality in series

Quality assurance in series production starts with a visual inspection. This is an automatic optical inspection (AOI) based on an ideal picture. In this way, any mechanical deviations, such as short circuits, positioning errors, breaks or incorrect components mounted on the printed circuit boards can already be identified. Bachmann either removes any affected boards or reworks them. The detected faults are then reported back to the preceding process in each manufacturing and test step so that systematic problems can be rectified immediately. The subsequent InCircuit test (IC) applies power to the controller boards and is the first electrical test in the production process. This can detect fault patterns such as the following: short circuits, missing components, incorrect component orientation, tolerance problems, incorrect component values or unsoldered components.

Bachmann's high standard of quality assurance is particularly demonstrated by the so-called run-in test, a climatic and function test, which every module has to undergo before shipment. For this continuous testing of the finished product the modules are placed in climatic chambers, in which they are switched on and off continuously at a particular rhythm for 48 hours and also through extreme temperature changes. This process creates the artificial aging of devices and thus induces the failure of any defective components. The probability of failure of electronic components is normally at its highest during the first few

months of use and then not until the end of its service life. The expedited artificial aging provided by the run-in tests enables the more susceptible initial phase of a device's life cycle to be avoided. This means that if faults are to occur at all, then this happens in the test laboratory and not in operation. The 48 h run-in test thus makes a significant contribution to increasing the reliability and lifespan of Bachmann modules.

Intelligent design

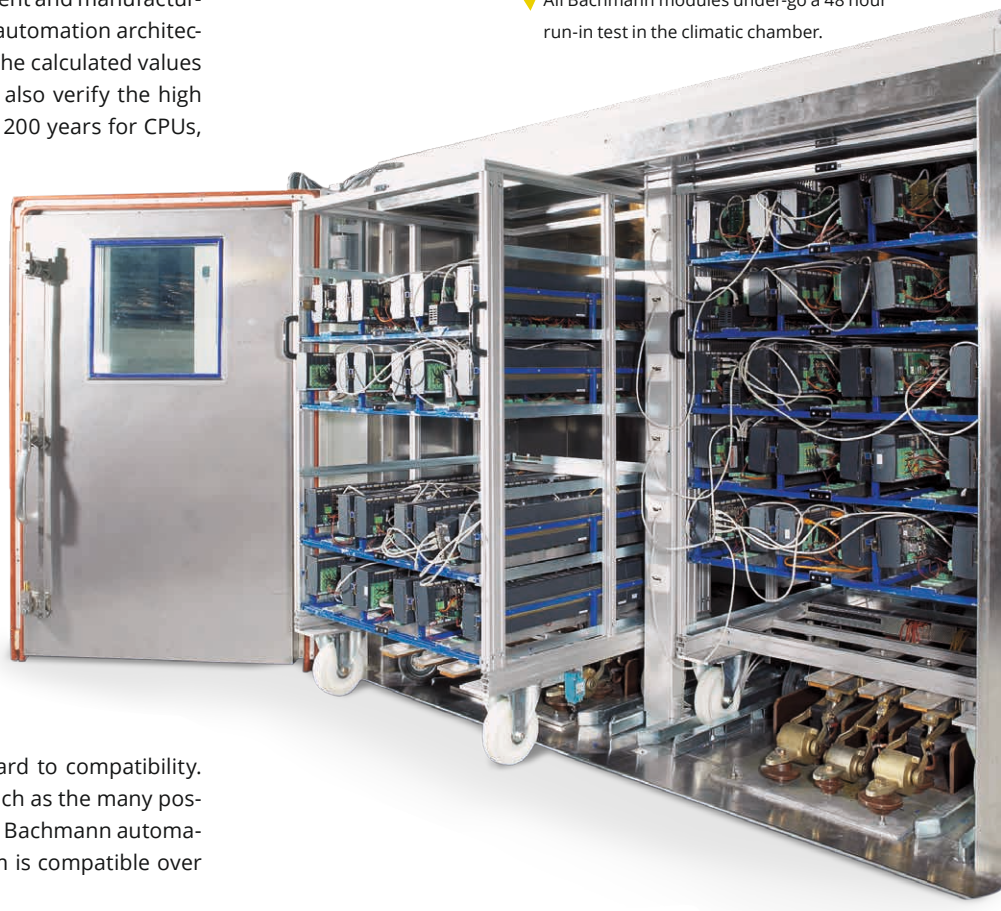
A design with maximum longevity is of key importance. Thanks to its considerable design reserves, the Bachmann modules have a particularly long service life. They are specified for ambient temperatures up to 60 °C, whilst only 50 °C is required as the market standard. This means that the modules have up to twice as high a lifespan during operation at ambient temperatures of below 50 °C. Thanks to the metal housing and high quality screw connections, the modules have a high degree of robustness. The high quality standards in product development and manufacturing have enabled Bachmann to implement automation architectures with a proven availability of 99.97 %. The calculated values for the mean time between failure (MTBF) also verify the high degree of reliability of the modules: This is 200 years for CPUs, up to 400 years for digital I/O modules and 200 years for analog I/O modules.

Compatibility

Besides the quality of the hardware and software, their compatibility for secure long-term availability is critical. Bachmann has therefore drawn up internal guidelines with clear rules for compatibility and which apply in parallel with the development guidelines. With this concept, Bachmann aims to enable the user to replace a CPU with a more powerful or newer one, to simply insert the memory card of the "old" CPU in the new one, and to restart the new one without any software adaption necessary, fully in line with the "plug and play" principle. Software design is playing an increasingly more important role with regard to compatibility. The architecture of the system software, such as the many possibilities of the engineering software for the Bachmann automation system, ensures that the user program is compatible over different controller generations. Bachmann's entire automation architecture is generally designed to be modular and open, with the ability to be expanded flexibly. This not only simplifies the use of the automation systems, but also increases long-term availability through the principle of backward or downward compatibility.

The hardware modules can also be configured flexibly. The latest generation of Bachmann's I/O or function modules offers the same functionality on delivery as the module to be replaced. The special feature is that new functions, which for example were not yet possible years ago with the first delivery, can also be added by simply configuring in Bachmann SolutionCenter. This multi-function capability leads in many cases to the possibility for several older modules to be replaced with just one new one.

All Bachmann modules under-go a 48 hour run-in test in the climatic chamber.



Benefit from our expertise

Bachmann Training Offerings

A solid know-how in conjunction with first-class products is the key to perfect automation. We offer you both. Take advantage of our extensive training program, which we will gladly adapt to your individual needs.

SolutionCenter

The SolutionCenter as an integrated and user-friendly engineering tool for project engineering, commissioning, configuration and diagnostics. The training also includes an introduction to programming and visualization.

Model Based Design

The MATLAB® program package from MathWorks offers a software tool for model-based development of controller applications. "M-Target for Simulink®" enables the user to integrate seamlessly in this development process inside the Bachmann controller environment.

M1 webMI pro

atvise® provides the user with a web-based visualization for different applications and visualizations. Mobile application, HMI up to SCADA solutions can be implemented with only one visualization. Standards such as HTML5, SVG and JavaScript enable very open and flexible solutions for any application. At the end of this training seminar each participant will have created an extensive sample project.

Redundancy Control

This training course provides a rapid introduction to configuring and creating redundant applications with the Bachmann automation system.

Power Management

The safety and efficiency of the electrical energy supply are placing increasing demands on generation, transmission and consumers. This training seminar provides the knowledge required to use Bachmann grid measurement, monitoring and synchronization modules in the Bachmann controller system.

Safety Control

This seminar offers a practical and basic understanding of how to implement functional safety. You are shown how to program safety applications based on the Bachmann safety products in hardware and software.

Always keeping up-to-date

Engineering training seminars

Even if the training needed for engineering is kept to a minimum thanks to the standard development environment: Updating and deepening one's knowledge of individual engineering areas at regular intervals is worthwhile. The combination of the user's sound knowledge with first-class products is ultimately the key to perfect automation.

BENEFITS

- *Perfect program adaption to individual requirements thanks to the modular concept*
- *Intensive knowledge transfer through hands-on training*
- *Training seminars held on site at Bachmann or as webinar*
- *Access to the in-depth knowledge of Bachmann application engineers*

More on this topic is provided on our website

Precisely tailored training seminars

Bachmann's training offering ranges from the proven standard training seminars right through to workshops tailored to your individual requirements. The modular training concept enables the creation of training programs tailored precisely to company requirements. The training is always centered around an intensive knowledge transfer and hands-on practice with special problem solving tasks. The training sessions are held either in a Bachmann branch office or directly on site at the customer's premises. Individual modules can also be offered as webinars if required. Following each training course, the participants will receive a personalized certificate.

No questions unanswered

If a question remains unanswered despite the extensive training offer, Bachmann customers benefit from the know-how of several application engineers. These work in close proximity to the development team. They know every small detail of the Bachmann solutions and can therefore make use of all options available.

Basic Training	User Training	Advanced Training
Basic knowledge of automation required	Basic training and specific knowledge recommended	Basic training and specific knowledge of programming required
Bachmann automation	PLC programming	Energy Applications
		Redundancy
		bluecom (Ethernet real-time protocol)
	Visualization M1 webMI pro	Advanced Visualization M1 webMI pro
	atvise® scada	
	Grid measurement and monitoring	
	Industry-specific trainings	
	CHP Template	
	Fieldbuses	
	Telecontrol protocols	
		Programming with C/C++ Developer
		Application development with M-Target for Simulink®
Safety technology	Safety technology (Safety Developer)	Model-based development with MATLAB®/Simulink®
Service technician		Customer-specific workshops

Trust through Expertise

Applications in energy technology

Many of the leading global manufacturers and operators of energy plants rely on us. Together with them, we are setting new benchmarks and achieving new success.

With the launch of its "avus 500 plus" combined heat and power plant, 2G has set a new milestone in energy efficiency – and with an electrical output of 550 kW and an efficiency of 42.6 % has impressively emphasized its technological leadership. The avus series is once more controlled by the Bachmann automation system.

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The economical use of valuable raw materials and the considerably reduced environmental impact through the reduced production of toxic substances are key reasons for the use of combined heat and power units (CHP units). Bayern BHKW GmbH, based in Dorfen, Germany, produces compact combined heat and power modules and has an extensive knowledge base in this field. The company has relied on the automation system from Bachmann electronic for controlling and monitoring its systems.

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The expansion of renewable energy as an alternative to nuclear energy is one of the pillars of the energy transition. This requires the energy share in electricity generation from sun, wind etc. to be 40 to 45 % by 2025 and 55 to 60 % by 2035. Renewable energies are already number 2 in the energy mix with over 33 %. The energy supply is thus becoming environmentally friendly. The second pillar of the energy transition is energy efficiency. The use of decentralized energy production, such as from combined heat and power systems, plays an important role here. enertec Kraftwerke GmbH is a specialist in these particularly energy-efficient systems.

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The energy transition has put the spotlight on renewable energies as key sources of energy supply. In this process, the redesign of the power supply grid is of critical importance: After all, a wide range of different energy producers have to be integrated. The fact that the energy from the sun, wind and other sources cannot be supplied at a constant rate poses a major challenge. The PNI testing laboratory for grid integration at the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) in Kassel, Germany, provides the facilities for testing the necessary innovations on grid components and for testing grid operation in practice. It is here that Bachmann's GMP232 grid measurement module is making an important contribution.

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Test stands for combustion engines are apparatus with an extremely high level of technical complexity. They must ensure reproducible operating conditions irrespective of external factors and must protect persons and the engine at the same time. They must also be highly flexible since virtually any test object requires an individual test setup.

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The main ridge of the Zillertal Alps in Austria at well over 2,000 meters above sea level is the source of several large streams that merge at 600 meters above sea level in the area near Mayrhofen in Austria. This water supply is used by the hydroelectric power plants of the Zillertal group. The upgrading of the entire control system in several stages between 2010 and 2014 has been the responsibility of Rittmeyer AG, a company based in Baar, Switzerland. For a long time, the company has relied on the automation system from Bachmann electronic.

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The worldwide supply of energy is in a state of transition due to the several international programs for reaching climate targets. Regenerative energy, such as wind power, photovoltaics and biogas, will play a decisive role in the energy supply mix of the future. Schäfer Elektronik GmbH is a company that has developed a modular battery storage system that also offers "low-voltage-ride-through" operation in real time.

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There are many places in the world where a reliable energy supply can only be implemented by using diesel generators. This may be due to the absence of a supply grid, wars, armed conflicts and natural catastrophes, as well as the geographical factors such as islands. Photovoltaic installations and wind turbine plants provide alternative technologies for power generation. However, these are strongly dependent on the prevailing weather conditions. The Qinous "ESS" energy storage system combines diesel generators and power generators from renewable energy sources together in an island grid to ensure reliable operation – round the clock.

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Reliable grid operation fed 100 % by renewable energy sources is one of the key objectives of the energy transition. Younicos, a supplier of battery-based smart grid and energy storage solutions, has devoted itself to this goal. Besides battery technology, smart software and not least robust and modular control technology play a major role here.

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