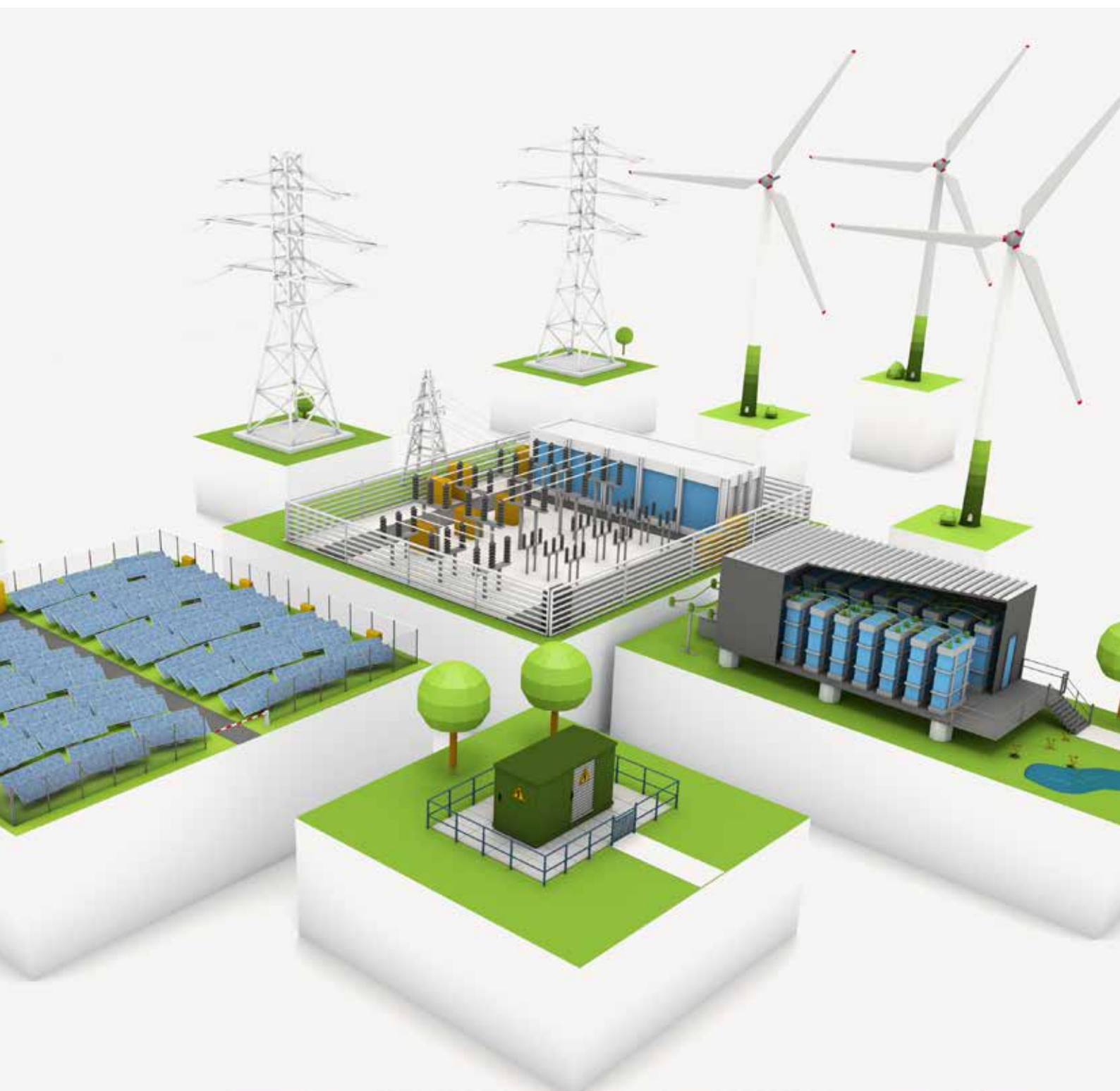


Power Engineering

Power Grid Products and Solutions



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SMART GRIDS FOR THE ENERGY MARKET

Beyond mere energy distribution, the interplay between decentralized producers and consumers must be intelligently controlled. This requires sophisticated digitalization strategies and business models.

High-tech control systems and IT form the basis for digitalizing the energy system: Controllers coordinate the decentralized systems, ensure easy and secure communication in the smart grid and store measurement data that's protected against cyberattacks in the cloud.

WAGO offers the right solutions and concepts today for every step of the process.



Advantages of our technology:

- Reliable, process, measurement and control of grids
- Process automation, load management
- Secure and economical access to remote systems
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



Upgrading the electrical system up to the distribution box

SMART GRIDS: MORE COMMUNICATION IN ENERGY GRIDS

An energy consumer needs communication, both between the individual stakeholders and interest groups as well as in technical terms: To get a grip on the increasing decentralization and fluctuation of power generation, individual components of an energy system must be linked to each other in smart grids across sectors. The start is in the electricity sector: Modern automation technology, integrated into decentralized suppliers, intelligent distribution substations and virtual power plants optimize control of the distribution grid. Modernizing the gas and heat grid is the next step, and WAGO provides the necessary controllers.

Advantages of our technology:

- Reliable, process, measurement and control of grids
- Process automation, load management
- Secure and economical access to remote systems
- Broad product portfolio
- Proven, rugged products
- All relevant worldwide approvals
- High level of flexibility on the signal level and in bus protocols
- Easy configuration
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper.
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



INTEGRATED ENERGY: ELECTRICITY, HEAT AND TRANSMISSION GROW TOGETHER

With decentralization and digitalization of the electricity sector, heat and mobility have become priorities for utility providers. Energy transition only works with storage systems. In contrast to the electrical grid, the heat and gas networks offer greater capacities. For that reason, power-to-heat and power-to-gas systems are becoming more important. They can use excess green electricity to produce heat, along with storable hydrogen and methane. WAGO already supplies manufacturers of such systems. At the same time, we support suppliers in modernizing their heat and gas networks that becomes necessary by energy sectors linking and increasingly complex energy flows. And the tried-and-true WAGO-I/O-SYSTEM serves as the automation platform.

Advantages of WAGO's solution:

- Automation solutions
- Highly flexible
- Direct applications in Ex Zone 2
- Direct wiring of intrinsically safe signals from Ex zones to intrinsically safe Ex i modules
- Integrated IEC 60870, IEC 61850 and DNP 3.0 telecontrol protocols
- PLC functionality
- Webservice



CLOUD-CONNECTIVITY: DATA ANALYSIS IN CLOUD COMPUTING

The cloud can offer significant advantages to the energy sector with its computing capacity. As an example, wind farm operators can increase power production and optimize wind farm maintenance by analyzing turbine data in the cloud. Grid operators can use system data and weather forecasts to better predict grid status. WAGO PFC100 and PFC200 Controllers are used to connect to the cloud thanks to a firmware update and the respective library in the IEC program. The controllers can then automatically transmit field-level values to the cloud at definable intervals. Communication is secured by an encrypted TLS connection using the MQTT protocol.

Advantages of WAGO Cloud Data Control for your own cloud application:

- Distributed data acquisition and visualization from anywhere
- Linking to WAGO Cloud Data Control, Microsoft Azure, Amazon Web Services or IBM Bluemix using a standardized MQTT protocol
- High level of security thanks to TLS encryption
- Connect the field level directly to a cloud
- Expansion of existing systems with the PFC as an IoT gateway
- Possible with all PFC100 and PFC200 Controllers

CYBERSECURITY: DENYING ACCESS TO HACKERS

There can be serious consequences for energy producers if they aren't securely connected to the Internet. Cybercriminals can use system controllers to hack into control centers and shut them down, jeopardizing the power supply and even threatening wide-range blackouts in a worst-case scenario. The good news: Operators now know the dangers and cybersecurity is becoming more important. WAGO controllers will play a crucial role in your company's security policies and procedures. PC-based operating systems must receive weekly security updates as they do not otherwise provide sufficient cybersecurity; the hardened firmware of a WAGO controller, however, does meet the corresponding security requirements.

Advantages of WAGO's solution:

- The PFC100 and PFC200 are characterized by cross-platform real-time Linux
- The PFC controllers use an open-source operating system that can be scaled, updated and supports tools such as Rsync
- The Linux® foundation supports essential security protocols and is constantly being enhanced.
- Support for CODESYS PLC runtime
- Interface and fieldbus diversity: CANopen, PROFIBUS DP, DeviceNet, MODBUS TCP, IEC 60870, IEC 61850 and DNP 3.0
- Maximum security requirements per ISO 27000 series
- On-board VPN functionality: VPN tunnel possible via IPsec or OpenVPN directly
- Data encoding in the controller directly via SSL/TLS 1.2 encryption
- Parallel data access: Data transmission to the cloud via an MQTT or OPC UA, also wireless
- WAGO meets all relevant guidelines in the area of IT security, and even a large number of the requirements from the German government's BDEW white paper for applications in the field of energy and water supply. BDEW requirements are part of the "critical infrastructure" (KRITIS)
- PFC200 can be used as a scalable node

Gateway for data thieves: Data centers





SECURE CONNECTION TO ENERGY TRANSITION

The main objective of the power generation and distribution industry is ensuring power supply safety and reliability. WAGO products provide the greatest degrees of safety and quality. We have a complete line of products from connection technology to automation solutions.

Operators of ecopower plants fiercely compete for the cheapest kilowatt hour and must pay attention to efficiency and low costs when installing their systems. They are also required to connect systems of a certain size to the control system of the grid operator so that they can be down-regulated remotely as required. That requires telecontrol communication.



Advantages of WAGO's telecontrol solution:

- Direct communication between telecontrol system and power inverter or to solar system data logger
- Separate ETHERNET interfaces permit the creation of parallel networks
- Cybersecurity: Encryption that follows Europe's most stringent energy and security guidelines per BDEW and BSI
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Password-protected Web-based management prevents unauthorized users from changing system settings
- Implementing the requirements of the respective grid operator for active power feed-in and reactive power supply
- $\cos \varphi$ or Q/U control (reactive power control) according to the characteristic
- Integration of external measuring systems from medium-high voltage (network measuring devices, short circuit indicators, network and system protection) via MODBUS TCP/RTU or other fieldbus protocols
- Recording of low-voltage performance data via 3-phase power measurement module



Solar energy fluctuates and must be regulated.

SOLAR FARM MANAGEMENT: PHOTOVOLTAIC NETWORK-FRIENDLY CONTROL

To enable communication between electricity producers and grid operators, the operators of photovoltaic power plants revert to telecontrol protocols. WAGO Controllers provide a standardized and easy-to-use interface for users based on the IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420 (Server/Client), MODBUS, DNP3 standards.

Advantages WAGO's telecontrol solution:

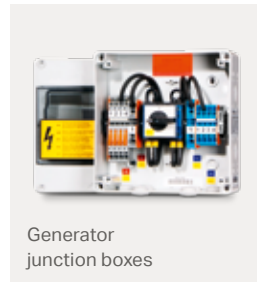
- Direct communication between telecontrol system and power inverter or to solar system data logger
- Separate ETHERNET interfaces permit the creation of parallel networks
- Cybersecurity: Encryption that follows Europe's most stringent energy and security guidelines per BDEW and BSI
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Password-protected Web-based management prevents unauthorized users from changing system settings
- Free function blocks for expanded capabilities, e.g., data loggers and inverters
- Implementing the respective grid operator's requirements for active power feed-in and reactive power supply
- Q/U control according to the characteristic
- Integration of external measurement systems from medium-high voltage (network measuring devices, short circuit indicators, network and system protection) via MODBUS TCP/RTU
- Recording of low-voltage performance data via 3-phase power measurement module
- Simple parameterization and configuration via visualization
- Modular design: Digital I/O modules, analog I/O modules and specialty modules can be combined within a node
- Select from more than 500 different I/O modules
- Parameterization/configuration via Web visualization
- Programming per IEC 61131-3
- Use of an integrated mobile radio modem

**Advantages of the TOPJOB® S
DIN-Rail Terminal Blocks:**

- Push-in CAGE CLAMP® connection or all conductor types
- Tool-free termination of solid conductors (Push-in CAGE CLAMP® connection)
- Space-saving, compact design
- Robust jumper system with full nominal current



String Combiner Box



Generator junction boxes



TOPJOB®S Disconnect Terminal Blocks

**Advantages of the 2006 Series
TOPJOB® S Disconnect Terminal Blocks:**

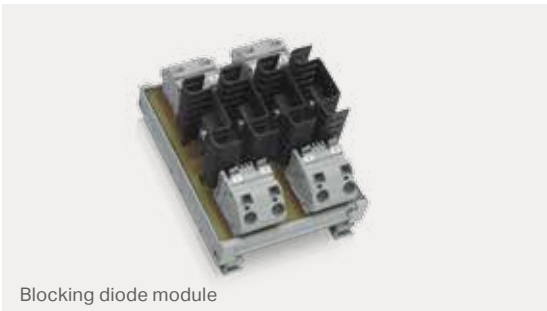
- Support 1,500 VDC IEC/1,000 VDC UL applications
- Available as disconnect, carrier and through terminal blocks
- Compatible with existing TOPJOB® S Series

**Advantages of the 811 Series
Fuse Terminal Blocks:**

- Easy-to-use design and safe installation via simple lever actuation
- Jumper bar for quick and convenient commoning



Fuse terminal blocks



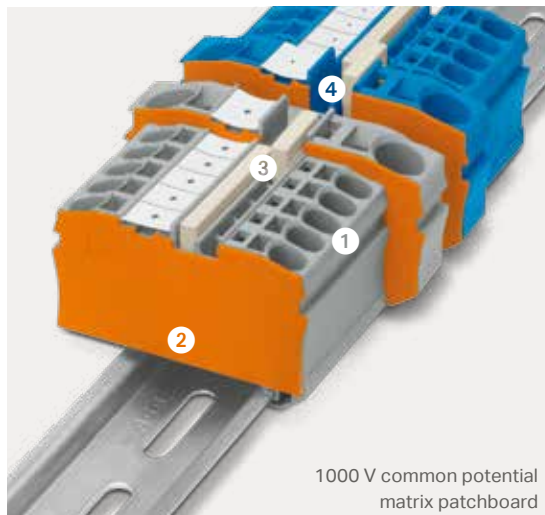
Blocking diode module

**Advantage of the 288 Series
Blocking Diode Module:**

- Fast and reliable protection against backflow in thin-film module applications

Installation guideline for 1000 V common potential matrix patchboard for photovoltaic systems

- 1 Potential to potential
- 2 Potential to DIN-rail
- 3 Commoning individual terminal blocks creates a common potential:
There are then no clearance and creepage distances from potential to potential. The remaining clearance and creepage distances from potential to DIN-rail are sufficient for 1000 V applications.
- 4 Multiple blocks of different potentials (+, -), located next to one another on a DIN-rail are separated by an end stop of at least 6 mm wide.



1000 V common potential matrix patchboard



Solar engineer connecting an inverter

SOLAR INVERTERS: MORE COMPACT AND DURABLE WITH WAGO

The inverter is the heart of the photovoltaic system. It converts the direct current from solar modules into an alternating current, which is then fed to the public power grid. The devices have very little loss with an efficiency up to 99 percent. In other words: Only one hundredth of the DC power is lost during conversion. The durability and performance of an inverter is determined by its electronic and electromechanical components. They must work reliably for many years and ensure high functionality and safety in small spaces. High-current PCB terminal blocks from WAGO meet those requirements.

Advantages of the 2706 and 2716 Series:

- Simple, easy-to-use design per lever
- Several clamping units can be held open simultaneously – convenient for terminating multi-core cables

Advantages of the 828 Series Feedthrough Terminal Blocks:

- Easy-to-use design, rated up to 1000 V / 41 A
- Easy, tool-free installation
- Several clamping units can be held open simultaneously – convenient for terminating multi-core cables
- 600 V UL



Substation at the foot of a wind farm

WIND FARM MANAGEMENT: POWER PRODUCTION IN COMPLIANCE WITH THE GRID

Wind turbines have modern electronic controls. The main controller as the central element is in constant contact with peripheral control elements, such as the wind tracking system and the blade adjustment system. This contact ensures optimal operation in any weather by changing individual system parameters. Proper infeed of the turbines in the power grid requires constant monitoring of the system's grid connection. Grid variables such as voltage, current and frequency are recorded and continuously sent to the plant control system to ensure an immediate response to defined limiting values that have been exceeded. WAGO supports wind farm management and ensures smooth communication with the grid operator, direct marketer and turbine operator. This allows the players delay-free access to the system without delay. The WAGO-I/O-SYSTEM 750 ensures that wind farms can be controlled and monitored fail-safe.

Advantages of WAGO's telecontrol solution:

- Communication via telecontrol protocols per IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420, MODBUS, DNP3
- Thanks to numerous I/O modules, the I/O system is ideal in the distribution grid, e.g., for serial communication with external devices or for 3-phase power measurement
- Convenient measurement and monitoring of generation or consumption rates (e.g., voltage, reactive power, active power, current, $\cos \varphi$, frequency and energy flow direction)
- Controllers available for all common fieldbus systems and ETHERNET standards
- Separate ETHERNET interfaces permit the creation of parallel networks
- Programmable via CODESYS per IEC 61131-3
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Password-protected Web-based management prevents unauthorized users from changing system settings
- Function blocks available at no cost
 - OPX/XML client
 - IEC 61400-25 client



Biogas plant fermenters

BIOENERGY: SAFE AUTOMATION EVEN IN HAZARDOUS AREAS

A biogas plant is used to produce biogas by fermenting primarily renewable raw materials or manure. In most cases, the gas is fed directly to local combined heat and power (CHP) plants and then fed into the public power grid. However, biogas can be processed into biomethane just as easily and fed into the natural gas network or converted in remote CHPs for decentralized local heating use. The WAGO-I/O-SYSTEM is used in all areas – whether in the automation of individual processes, in controlling processing plants or in connecting the generation plant to the control system of the grid operator or the supplier of control energy.

Advantages of WAGO's telecontrol solution:

- Communication via telecontrol protocols per IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420, MODBUS, DNP3
- Thanks to numerous I/O modules, the I/O system is ideal in the distribution grid, e.g., for serial communication with external devices or for 3-phase power measurement
- Convenient measurement and monitoring of generation or consumption rates (e.g., voltage, reactive power, active power, current, $\cos \phi$, frequency and energy flow direction)
- Controllers for all prominent fieldbus systems and ETHERNET standards
- Process signals in Ex zones can be connected to intrinsically safe Ex i modules from WAGO directly.
- Separate ETHERNET interfaces permit the creation of parallel networks
- Programmable via CODESYS per IEC 61131-3
- Web visualization allow you to visualize sub-processes in the cabinet door or on the screen directly
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



Storage power station in the Alps

HYDROPOWER: FORCES FIRMLY UNDER CONTROL

Renewable energy from hydroelectric plants is an important part of the global energy transition. A high level of automation is required to operate hydroelectric plants economically. Among other things, WAGO solutions can be found in turbine controls that are connected to a higher-level SCADA system for monitoring and power station control.

Advantages of WAGO's telecontrol solution:

- Communication via telecontrol protocols per IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420, MODBUS, DNP3
- Separate ETHERNET interfaces permit the creation of parallel networks
- Cybersecurity: Encryption that follows Europe's most stringent energy and security guidelines per BDEW and BSI
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Password-protected Web-based management prevents unauthorized users from changing system settings



STABLE POWER SUPPLY WITH SUN AND WIND

An increasing energy supply from mercurial regenerative sources changes the need for system services and requires greater flexibility in energy supply. WAGO supports grid operators who intelligently link and control renewable power.

The share of renewable power is increasing steadily and rapidly internationally. The fluctuating power from photovoltaics and wind, however, has disadvantages for grid management. The unstable supply makes it more difficult to predict generation output and ensure grid stability. But there are solutions that relieve the load on the grid.



Advantages of WAGO's solution:

- Broad product portfolio: From simple step control with or without an emergency stop command to $\cos-\varphi$ or Q/U control
- Direct coupling to the solar farm or wind farm computer via OPC-XML, Soap or MODBUS RTU/ TCP possible
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Trouble-free connection of individual systems to a virtual power plant
- Measurement of performance values via existing meters, e.g., via S0 impulse, IEC 62056-21 or SML



Solar power plants may be remotely controlled.

FEED-IN MANAGEMENT: TARGETED THROTTLE DOWN OF SUN AND WIND

To ensure system security as renewable energy sources increase, grid operators can reduce the feed-in capacity of solar and wind farm systems remotely in the event of grid overload. The Renewable Energies Act (EEG) stipulates the regulations depending on the plant's output. Depending on the required signal range, WAGO assembles the appropriate telecontrol solution for you from more than 500 different I/O modules.

Advantages of WAGO's solution:

- Broad product portfolio: From simple step control with or without emergency stop command to $\cos-\varphi$ or Q/U control
- Direct coupling to the solar or wind farm's computer via OPC-XML, Soap or MODBUS RTU/TCP possible
- Communication from the system according to custom requirements
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



Photovoltaic, battery and power-to-gas merge.

VIRTUAL POWER PLANTS: PRODUCTION AND NETWORK CONSUMPTION INTELLIGENTLY

In virtual power plants, decentralized generators, storage systems and controllable loads, such as emergency generators or production systems, form a flexible and adjustable combination. Intelligently synchronizing these reduces loads on the power grid. WAGO telecontrollers meet the requirements of the VHPready 4.0 communication standard, ensuring trouble-free connection of systems.



Advantages of WAGO's solution:

- Trouble-free connection of individual systems to the virtual power plant
- VHPready standardizes the objects and variables of different communication protocols
- Communication via predefined profiles using explicitly defined data point lists
- VHPready defines domain-specific definitions, such as specifications for operating behavior and reaction times. This allows systems to be controlled by timetables
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- IEC 60870, IEC 61850 or DNP3.0 also allow systems to be coupled



Offshore wind farms can also provide reserves.

OPERATING RESERVE: FIRST AID FOR THE GRID

An operating reserve compensates for grid fluctuations. If operators of virtual power plants or individual generators and controllable consumers supply this power to the responsible transmission grid operators, they can generate additional revenue. For operating reserves, a distinction is made between primary, secondary and minute reserves that must be supplied within seconds, five minutes and 15 minutes respectively. Due to high standards for signal diversity, cybersecurity and availability, flexible, safe and rugged controllers are essential.

Advantages of WAGO's solution:

- Selection of more than 500 different I/O modules
- Direct coupling to the solar or wind farm's computer via OPC-XML, Soap or MODBUS RTU/TCP possible
- Communication from the system according to custom requirements
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



Instead of feed-in remuneration: Electricity sales on the open market

DIRECT MARKETING: SELL GREEN ELECTRICITY PROFITABLY

Direct marketing means the sale of electricity from renewable energy sources to large customers or via the electricity exchange. Direct marketing distinguishes between mandatory direct marketing of new systems and optional direct marketing of existing systems. Green electricity is treated similarly to conventionally generated electricity and sold at the same market price. After the sale, the sales revenue from the electricity exchange is paid to the system operator together with a market premium to generate additional revenue. In traditional direct marketing of EEG systems, operational readiness and efficiency are captured. In addition, setpoints for the active power are specified as a staircase signal or sliding.

WAGO provides the right solution for every application:

- Selection of more than 500 different I/O sub-assemblies
- Measurement of active power via 3-phase power measurement modules
- Measurement of performance values via existing measurement devices, e.g., MODBUS RTU/TCP/UDP, PROFIBUS
- Measurement of performance values via existing meters, e.g., via S0 impulse, IEC 62056-21 or SML
- Direct coupling via inverter protocols, solar farm controllers or wind farm computers
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



MODERNIZATION ON ALL LEVELS

Automation of energy grids has many advantages. The advantages include the possibility of monitoring and remote control. WAGO has the right solutions.

In the first step, grid operators can use WAGO technology to precisely identify where their infrastructure must be modernized. Our controllers can then be used later to automate processes and support load management. In this way, grid capacities can be better utilized – and can reduce the need for new lines.



Advantages of WAGO's solution:

- Versatile: The controllers, which are freely programmable via CODESYS, collect all data from the substation's various systems via digital and analog signals (e.g., via MODBUS RTU)
- Multilingual: Our controllers translate the data into supplier-required communication protocols (e.g., IEC 60870-5-101/-104, IEC 61850 or DNP 3.0) and transmit it to the control center via data line
- In the opposite direction, the control center can access the substation's systems (e.g., medium-voltage control cabinet, protective devices, measurement systems from different manufacturers) via WAGO Controllers
- Cybersecurity: The data flow from WAGO controllers is protected against unauthorized access by encrypting the data using TLS1.2 and by transmitting the data via specially secured connections, such as IPsec or OpenVPN, according to the BDEW White Paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Fast reconnection of grid segments
- Measured values from low and medium voltages can be transmitted continuously to the control center
- Monitoring helps asset management in future grid planning



Intelligent distribution substation of Ingenieurbüro Pfeffer

INTELLIGENT DISTRIBUTION SUBSTATIONS: KEY TO THE SMART POWER GRID

Just like conventional local power stations, the intelligent distribution substation (iONS) connects the medium- and low-voltage grids. Unlike its less advanced counterparts, however, the new substation also records measurement data and allows this data to be read remotely. WAGO is ready to support an iONS with comprehensive automation technology: The PFC200 Controller on the medium-voltage side and the e!DISPLAY on the low-voltage side for visualizing the measurement and control data directly at the iONS itself, as well as complete connection technology.

Advantages of WAGO's solution:

- Versatile: The controllers, which are freely programmable via CODESYS, collect all data from the substation's various systems via digital and analog signals (e.g., via MODBUS RTU or IEC 61850)
- Multilingual: Our controllers translate the data into supplier-required communication protocols (e.g., IEC 60870-5-101/-104 or IEC 61850) and transmit it to the control center via data line
- In the opposite direction, the control center can access the substation's systems (e.g., medium-voltage control cabinet, protective devices, measurement systems from different manufacturers) via WAGO Controllers



Driescher switchgear before delivery

MEDIUM VOLTAGE SWITCHGEAR: AUTOMATE WITH WAGO

Switchgear in the distribution grid is a central component of a secure power supply. To ensure this, automation of such stations with WAGO controllers is an excellent solution. Faults can be quickly localized by connecting the short circuit and ground-fault direction indicators and transmitting the information, while automated systems can be remotely controlled. Parts of the power grid can then be quickly restored and the damage radius is minimized.

Advantages of WAGO's solution:

- Fast reconnection of grid segments
- The service technician can be sent directly to the fault location
- Measured values from medium voltage can be transmitted continuously to the control center
- Monitoring helps asset management with future grid planning



Substation conduits

SUBSTATION: NETWORK NODES ALWAYS IN VIEW

Substations are the interface between generation and distribution of renewable energy. In the event of failure, connected generators such as solar and wind farms, can no longer feed into the power grid. Depending on the severity and duration of the interruption, considerable loss of profit or other damage to technical systems may occur. To avoid failures and eliminate faults in the near term, remotely monitoring and controlling substations in the event of breakdown are essential. WAGO controllers can handle this task safely and reliably.

Advantages of WAGO's solution:

- Precise fault localization
- Fast reconnection of grid segments
- The service technician can be sent directly to the fault location
- Measured values can be transmitted continuously to the control center



DREWAG gas pressure regulating station

GAS SUPPLY: SAFETY CONTROL PRESSURE

A safe gas supply is just as important as a safe power supply. To ensure a safe supply, monitoring and control of gas pressure regulating systems and coupling stations are indispensable. In addition, the gas network is becoming increasingly important for integrated energy. Due to large storage capacities within a gas network, large amounts of energy can be stored. That also makes automation of feed-in stations necessary.

Advantages of WAGO's solution:

- Quick troubleshooting
- Online measurement
- PLC functionality allows implementation of complex regulations and control
- Implementing all current fieldbus systems, e.g., PROFIBUS DP or MODBUS RTU/TCP, allows for integration of third-party systems
- Telecontrol protocols such as IEC 60870 or DNP 3.0 allow you to connect to the central control system
- Intrinsically safe I/O modules allow integration of signals from Ex zones 0, 1 and 2 in the WAGO-I/O-SYSTEM
- Integrated Web visualization allows the display of processes on site or via remote access



Flensburg municipal heat transfer station

HEAT SUPPLY: ALWAYS THE RIGHT TEMPERATURE

Combined heating and power (CHP), along with the associated construction and expansion of remote and local heating networks, is an important component of energy transition. During implementation, that means that heat coupling and transfer stations must be safely automated. Of course, the customer requires a secure supply in the cold season – failure here would be fatal!

Advantages of WAGO's solution:

- Precise fault localization
- Quick troubleshooting
- Online measurement
- PLC functionality allows implementation of complex regulations and controls
- Telecontrol protocols such as IEC 60870 or DNP 3.0 allow you to connect to the central control system
- Implementation of all current fieldbus systems, e.g., PROFIBUS DP or MODBUS RTU/TCP, allow for integration of third-party systems.
- Integrated Web visualization allows the display of processes on site or via remote access



ASSET MANAGEMENT DECENTRALIZED SYSTEM OVERVIEW

The demand for asset management is growing among companies digitizing the energy transition.

With the 750 Series decentralized automation system, WAGO provides the ideal platform for collecting data. Due to the hardware's complete flexibility, including the protocol and software levels, integrating existing systems is economically feasible. **WAGO Cloud Data Control** is the link and central element for effective system management. It allows access to current data regardless of location.

The IoT Controller: A plug-in makes WAGO controllers IoT-ready

Using a simple MQTT software upgrade, any WAGO PFC can be transformed into an IoT controller with cloud connectivity.

Continuously monitoring decentralized systems, as well as third-party systems as a service provider, offers many advantages:

- Centralized data collection allows continuous analysis of the operating status
- Faults are detected quickly and failures avoided.
- Continuous monitoring allows detection of critical conditions before system failure
- Future system planning can be optimized



POWER AROUND THE CLOCK

Batteries, power-to-gas and power-to-heat systems promote power supply independence, free up the power grid and incorporate the mobility and heat sectors in climate protection – and all rely on WAGO controllers.

Storage systems capture excess energy and release it when necessary. This allows them to increase private consumption of solar by households and companies, to cap demanding current peaks and to supply operating reserves to compensate for short-term fluctuations on the grid. WAGO technology allows control of storage systems.



Advantages of WAGO's telecontrol solution:

- Connection of generators and heat accumulators via controller; grid-connected integration of electrolyzers for storing large amounts of electricity
- Convenient measurement and monitoring of generation or storage values (e.g., current, voltage, active power, reactive power, temperature and storage volume, as well as $\cos \phi$, frequency and energy flow direction)
- Generation and load management
- Integration of current consumption forecasts and weather data
- Connection to external market participants, such as suppliers and public utilities, direct marketers or virtual power plants via telecontrol in accordance with IEC 60870-5-101, -103 /-104, 61400-25, 61850-7-420, DNP3, VHPready
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



HOME STORAGE SYSTEMS: CONNECT BATTERIES QUICKLY WHILE MINIMIZING SPACE

The market for home storage systems is not only being stimulated by homeowners seeking to reduce their use of electricity from the grid by a combination of photovoltaic and battery storage. Suppliers also drive the sales of equipment as they can develop new business models. If batteries are sold together with solar modules and they are interconnected as a swarm, grid load can be reduced. WAGO provides the solution for installation of home storage. WAGO TOPJOB®S rail-mount terminal blocks can connect the system to a home's power distribution system.

RELIABLE PCB TERMINAL BLOCKS FOR POWER ELECTRONICS

WAGO's comprehensive range of PCB terminal blocks for power electronics are rated for 4, 6 and 16 mm² (12, 10 and 6 AWG), as well as 76 A. WAGO's compact and high-performance PCB terminal blocks are both easy to use and offer maximum wiring flexibility. They are available in two variants: with or without lever actuation.

Your benefits:

- Comprehensive product line-up, ranging from 0.2 to 25 mm²
- Push-in CAGE CLAMP® termination
- Wider conductor range and higher current carrying capacity
- Wire horizontally or vertically to the PCB
- Testing both parallel and perpendicular to conductor entry



DISCONNECT/TEST TERMINAL BLOCKS

Our disconnect/test terminal blocks allow you to quickly and safely disconnect circuits. The orange-colored knife disconnects or disconnect plugs are located between the conductors, and are always visible to the operator.



Your benefits:

- Alternative disconnect options: Via pivoting knife disconnect and additional mechanical interlock or via disconnect plug
- Save space with double-deck, double-disconnect terminal blocks: Two potential-free disconnect terminal blocks on two levels
- Service-friendly testing for potential ground faults via ground conductor disconnect terminal blocks
- Ideal for applications in the renewable energy sector with voltages up to 1,500 VDC (2006 Series)
- Same shape as corresponding through terminal blocks provides clear sightlines
- A wide variety of jumpers for safe and economical circuit requirements



Industrial storage systems feed charging stations.

LOCAL GRID, LARGE AND INDUSTRIAL STORAGE: REDUCING PEAK LOADS

Local grid storage systems regulate the voltage in the low-voltage grid to a preset value. A clear rise in voltage is concerning – especially at lunch time when photovoltaics are running at full speed. Using local network storage that takes in excess energy is an alternative to feeding it into the medium voltage level and to expanding the local network. In the evening or when the sky is overcast, the stored energy can be fed back into the grid. Load peaks in the network can be reduced. In addition, the grid operator can provide system services through the storage system such as operating reserves to generate additional revenue.

Mass storage systems are primarily used for frequency regulation. Transmission grid operators can supply operating reserves. If the mains frequency within Europe's integrated grid system spikes due to excess energy, the storage systems take in energy. If the frequency falls because too little energy is generated, the storage systems release energy.

Advantages of WAGO controllers as a central element of measurement and control technology:

- WAGO-I/O-SYSTEM 750 is ideal in the distribution grid, e.g., for serial communication with inverters or for 3-phase power measurement
- Convenient measurement and monitoring of generation or consumption rates (e.g., voltage, reactive power, active power, current, $\cos \varphi$, frequency and energy flow direction)
- Generation and load management
- Integration of the Battery Management System (BMS) via CAN or MODBUS into the controller
- Programmable control technology acc. IEC 61131 or Linux® platform
- Bundling supply rates by adaptation to central control systems
- Connection to external market participants, such as suppliers and public utilities, direct marketers or virtual power plants via telecontrol adhering to IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420, DNP3, VHPready
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade



Researchers at ZAE Bayern test the electrolysis.

POWER-TO-X: SAFELY CONVERTING ELECTRICITY TO HEAT AND GAS

If power is stored not only for short, but over longer periods, power-to-heat and power-to-gas systems are available. They convert excess power to heat and into storable hydrogen and methane. These products can be stored in the existing natural gas network that supplies heating systems, power stations and gas stations. Power-to-heat is ideal for use in applications generating high amounts of heat, e.g., district heating grids. Power-to-gas systems and electrolyzers also work if a dense network of hydrogen filling stations is planned in a region or reliable access to the natural gas network is available.

Advantages of WAGO's telecontrol solution:

- Connection of generators and heat accumulators via controller; grid-connected integration of electrolyzers for storing large amounts of electricity
- Multiple interfaces: PROFIBUS, CAN, Ethernet IP, IEC 60870/61400/61850, MODBUS, etc.
- Convenient measurement and monitoring of generator/accumulator parameters, e.g., active power, temperature and storage volume; regulation of process values, e.g., pressure regulators and product gas separators with explosion-proof modules
- Integration of current consumption forecasts and weather data
- Programmable per IEC 60870-5-101/-103/-104, 61400-25, 61850-7-420, DNP3
- Easy parameter setting via configurator
- Scalable due to more than 500 different I/O modules for many applications, e.g., 3-phase power measurement for grid analysis
- Cybersecurity: PFC100/PFC200 Controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade
- Standard I/O modules and intrinsically safe Ex modules in one control unit (depending on installation site in a corresponding Ex housing)

SCALABLE CONTROLLERS

for Telecontrol Technology

Fieldbus couplers

- Connecting the WAGO-I/O-SYSTEM 750 to the higher-level control system via fieldbus coupler
- Fieldbus-independent – support all standard fieldbus protocols and ETHERNET standards
- Space-saving design

Programmable fieldbus controllers

- Controllers for all prominent fieldbus systems and ETHERNET standards
- Quick commissioning
- Programmable via CODESYS per IEC 61131-3
- Directly connect to a wide range of I/O modules from the WAGO-I/O-SYSTEM 750
- Flexible platform adapts to diverse applications and environments

PFC200 Controller

- Rugged and maintenance-free
- Scalable performance
- Controllers for all prominent fieldbus systems and ETHERNET standards
- High processing speed
- Multiple communication interfaces can be used simultaneously
- Separate ETHERNET interfaces allow configuration of parallel networks
- WAGO-I/O-PRO Software
- Create your own firmware (Linux® developers online) thanks to the Linux® operating system

PLC for Telecontrol Technology

Item No.	750-880/040-001	750-8206/040-001
Approvals		UL
CPU		AR
Interfaces		
LAN	2 x RJ-45	
I/O interfaces (serial)		
Memory		
Non-volatile memory (retain)		
Program Memory		
Data memory		
Memory expansion		
Fieldbus (optional)		
Programming	WAGO-I/O-PRO v2.3	
Telecontrol protocols	MODBUS/TCP (UDP), EtherNet/IP	
Operating temperature	-40 ... +70 °C	-20 ... +70 °C
EMC: 1 – immunity to interference	Per EN 60870-2-1	Per EN 60870-2-1
EMC: 1 – emission of interference	Per EN 60870-2-1	per EN 60870-2-1

- IPsec and OpenVPN



750-880/025-001
750-880/025-002



750-880/040-001



750-8206/040-001

IEC-60870-5-101/-103/-104-Client/-Server
IEC-61850-Client/-Server
IEC 61400-25, DNP3



750-8202/025-001 750-8202/025-002*	750-8202/ 040-001	750-8202/025-001 750-8202/025-002*	750-8206/ 025-001 750-8208/ 025-001	750-8206/ 040-001	750-8207/ 025-001
UL 508, 1, GL		UL 508, C€, GL	UL 508, C€, GL		UL 508, C€, GL
19; 80 MHz	Cortex A8; 600 MHz				
	2 x RJ-45/Dual LAN				
	1 x RS-232, 1 x D-Sub 9, socket (switchable)				
32 KB	128 KB				
1 MB	16 MB				
1 MB	64 MB				
SD and SDHC up to 32 GB					
			PROFIBUS DP slave, PROFIBUS DP master (750-8208), CAN, CANopen		3G modem
Ethernet/IP, IEC 60870-5-101/-103/-104, IEC 61850 / 61400-25 3964R/RK512, DNP3					
-40 ... +60 °C	-40 ... +70 °C	-20 ... +60 °C		-40 ... +70 °C	-20 ... +60 °C
Per EN 61000-6-2	Per EN 60870-2-1	Per EN 61000-6-2		Per EN 60870-2-1	Per EN 61000-6-2
Per EN 61000-6-4	Per EN 60870-2-1	per EN 61000-6-4		Per EN 60870-2-1	per EN 61000-6-4

PFC200 Controller with a 3G Modem

- Sending / receiving SMS messages
- GPRS with 3G modem (UMTS)
- Temperature range: -20 °C ... +60 °C
- IPsec and OpenVPN



750-8202/025-001
750-8202/025-002



750-8206/025-001
750-8208/025-001



750-8207/025-001



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