

Substation Automation Systems

Overview

Today's power system requirements for performance, reliability, safety and economics demand not only high performance devices and components but also optimized integration both within the station and with the remainder of the power system.

The latest Efacec automation platform for substation automation, **CLP 500SAS** is a unified, flexible and scalable distributed system platform that provides smart solutions for protection, automation, monitoring, control and management of the substation of today while streamlining the path for the substation of the future.

Including an extended range of multi-functional protection relays and controllers, gateways and station SCADA/HMI products under a unified automation platform from product design to system engineering, **CLP 500SAS** provides a unique system foundation that can be custom designed for applications ranging from grid transmission and distribution, through railway electrification, to other utilities, industry and plants.

Systems can be deployed in different architectures from compact and economical solutions to full featured high-performance decentralized systems, including different levels of functional integration, redundancy and communication integration.

By adopting international standards such as IEC 61850, IEC 60870 or DNP it provides an open future-proof and straightforward solution that can integrate multi-vendor products and scale according to the needs of each project.

To support advanced engineering and management **CLP 500SAS** includes a unified system and device engineering tool which is both open and intuitive as well as highly productive, thus optimizing engineering and maintenance.

The field-proven and reliable **CLP 500** platform is complemented with a full range of services from training and product support to engineering, commissioning and maintenance that enable the required continued support throughout the whole system life-cycle.



Key Features

- Fully IEC 61850-enabled including RSTP or PRP redundancy options and open engineering
- Multiple standard communication protocols and I/O options
- Modular, scalable and secure architecture with multiple redundancy options
- Several device families
- Multiple HMI options including secure external mobile and web access
- IEC 61131-3 user programmability
- Unified control system engineering tool from programming to HMI design
- Strict conformance to industry standards
- Architecturally ready to support future process bus architectures

Customer Benefits

- User friendliness of devices, tools and HMI
- Field-proven application with extensive worldwide references
- Open and versatile substation automation solution
- High expansibility and adaptability enabling step-by-step evolution
- Reduced engineering effort
- Seamless integration with third party products and systems
- Low total cost of ownership without compromising reliability



Smart Substation Automation

The main hub of automation in utility operations is the substation and it is also one of the key assets for the smarter grids of tomorrow. The advent of new standards, high-performing devices and networking technologies brings forward a new era of smart substation automation, integration into utility area automation schemes and with enterprise information systems.

Grid managers are today looking at monitoring and management of substation data as part of their overall asset management and optimization strategy. Substations, where reliability is most critical, are one of the key focus points to further improve operations and maintenance, increase system and operational efficiency, and leverage or defer investment.

New improved engineering processes, tools and communication networks from process to station levels, backed with high levels of security and serviceability, enable the substation of future where standards provide seamless integration of conventional functions, such as critical protection and control schemes, with new real-time phasor-based monitoring, dynamic line rating, or equipment and environmental condition monitoring and diagnostics, at the lowest total cost of ownership.

Not only the introduction of renewables at all power levels but also distributed energy resources such as smaller-scale generation, storage or electric vehicles, together with economical energy management and demand response initiatives will require substation automation to manage reversible and increasingly dynamic power flows while maintaining operation within stability and technical limits as well as economical and QoS targets.

Primary distribution substations, for example, may soon systematically include new automated functions such as FDIR (fault detection, isolation and restoration), Volt/VAr control, loss minimization, or adaptive protection as substation automation extends into MV feeder automation and area control of active networks.

CLP 500SAS is the substation automation solution that delivers integrated, optimized and cost-effective systems throughout the entire lifecycle in strict conformance with industry and customer requirements while providing a foundation for future requirements as integrated substation automation becomes integrated grid automation.

Protection and Control Functions You Can Trust

A careful design of protection functions and device architecture in all **CLP 500SAS** multifunctional IEDs provides the best balance between speed, sensitivity and accuracy. Protection characteristics and algorithms were developed to guarantee stability during load and external faults while preserving dependability of operation for internal faults.

Besides main protection functions, such as busbar differential, distance, line differential or transformer differential, a broad set of auxiliary and backup functions as well as flexible communication scheme logic between different substations are integrated according to system requirements. Efacec has a long tradition of effectively and efficiently combining Efacec-own relays with third party products to provide reliable protection solutions for any substation.

Adequate design options provide correct fault selectivity and adequate coordination among IED from different manufacturers in the system. Furthermore, adaptive protection via multiple setting groups selectable according to user-defined conditions ensure the adaptation of function behavior to varying system conditions.

Complete integration in one single device of most usual protection and automation functions for different applications allow system designers to select the adequate level of functional integration according to reliability and maintainability requirements.

With multiple functional building blocks and prepared for information exchange either through hardwired connections or communication links such as IEC 61850 GOOSE, **CLP 500SAS** distributed protection and control functions may be deployed in different configurations including sophisticated automation schemes. **CLP 500SAS** is also prepared for PMU functionality, enabling future requirements for wide area protection and control algorithms.



Straightforward System Monitoring and Control

CLP 500SAS solutions integrate local SCADA and station historian through desktop, console and also web-based or mobile user interface platforms featuring 2D vector graphics, alarms management, reports and alerts and trending through the HMI 500 platform. From context-menus to easy navigation and topology-based animation, state-of-the-art operating principles deliver a concise view for operational purposes, system management and data analysis.





CLP 500SAS provides conventional control options including monitoring, measurement, events and telecontrol processing, including control interlocking, hierarchical authority, and select-before-operate execution for safe operation. All products support IEC 61131-3 programming, enabling logic functions to be implemented at all functional levels either for specific scheme logic, interlocking or general purpose automation.

Enhanced recording and fault analysis data can be generated, gathered and processed automatically for decision support in either operation or maintenance.

Different clock synchronization options from GPS, NTP, IRIG-B or telecontrol protocol enable precise time stamping of data and events.

Full self-diagnostics and troubleshooting tools, including system records and SNMP monitoring, are also included to enable simplified systems management.

Key Efacec CLP500SAS Products

 Station SCADA	Substation SCADA software featuring full vector graphics, alarms, historian, trending, statistics and reporting including full-featured web-based HMI.
 HMI Console	Local HMI consoles featuring multiple display options including touch-screens.
 Unit Controllers and Servers	Station-level servers and gateways available in different hardware platforms from standard industrial PC to embedded units with high availability/redundancy options.
500 IED Series Protection, Automation and Control	Targeting high-end applications such as utility transmission, the series 500 protection relays and controllers offer fast and reliable protection and control algorithms together with recording and monitoring. Extensive programmability, high and flexible I/O capacity, on-board HMI and high-availability options are also available.
420 IED Series Protection, Automation and Control	The series 420 protection and control relays are a full-featured solution for distribution substation automation, protection and control and other HV and MV protection applications. Different product variants provide field-proven protection and control for aerial lines/feeders and underground cables, capacitor banks or power transformers.
220 IED Series Protection, Automation and Control	The series 220 compact protection and control relays are a cost-effective secure solution for line/feeder protection as well as backup or auxiliary protection and control for transformers, generators and motors in HV/MV systems. The fit-for-purpose design allows plug-and-play engineering together with customization of protection schemes and user-defined logic.
 automation studio Integrated Engineering Tool	An “all-in-one” easy to use software that provides an open and productive life-cycle engineering environment for the whole substation automation system from programming and HMI design to configuration and management.



Meeting High-availability Requirements

Selected 500 series IEDs and station servers provide built-in redundant power supplies or redundant CPU and communication boards in addition to hot-standby modes for station servers to deliver high-availability levels.

As an option to RSTP redundancy, full duplication of Ethernet station bus using state-of-the-art PRP parallel redundancy protocol is also supported, ensuring full system availability in the presence of any communication component failure. This enables customers to benefit from the value and flexibility of distributed systems while maintaining the high reliability level of conventional hardwired architectures.

Unified Engineering Software

Configuration and management is performed in a single integrated tool for latest generation CLP 500SAS products, so that simplicity is not hindered by system architecture or application size.

Within an intuitive engineering environment, Automation Studio provides libraries, template and object based tools for SCADA database, communications, HMI screens and device programming that, together with IEC 61850 manufacturer-independent engineering, provide a straightforward engineering experience. The toolset includes simulation, debug/monitoring and system management features to support the system from design to operation.

Automation Studio can also be deployed with advanced features such as import/export tools, comparison tools and integrated configuration history server to effectively track configuration versions and changes and promote parallel teamwork.

Adopt the Best Fitting Architecture

CLP 500SAS supports multiple system architectures from conventional serial and hardwired systems, through IEC 60870-5-104 distributed buses to fully-compliant IEC 61850 systems, including peer-to-peer communication capabilities, protected by redundancy protocols such as RTSP or PRP.

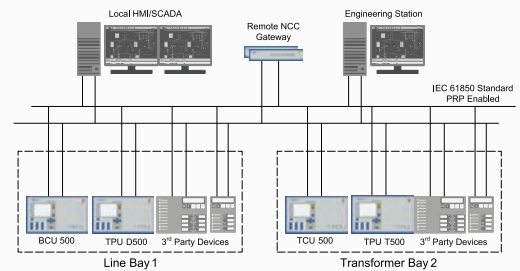
Such flexibility enables CLP 500SAS to adapt to specific system requirements, either in both new systems or substation expansion and remodeling projects. This enables a straightforward path for modernization and expansion to meet the requirements of today and of tomorrow.



Example CLP 500SAS Architectures

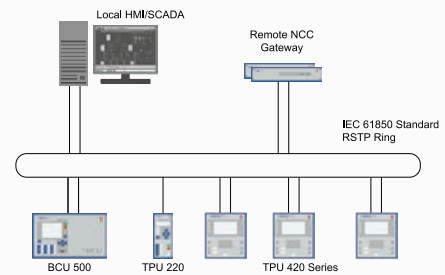
IEC 61850 Transmission Substation Automation

- Local HMI/SCADA
- Remote NCC communications via redundant gateways
- Independent protection and control
- Main 1 / Main 2 protection philosophy
- Multi-vendor integration
- PRP-enabled station bus architecture



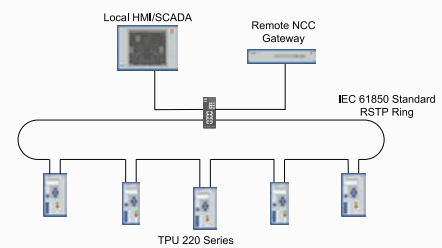
IEC 61850 Distribution Substation Automation

- Local HMI/SCADA
- Remote NCC communications via redundant gateways
- Integrated protection and control
- RSTP ring architecture for station bus



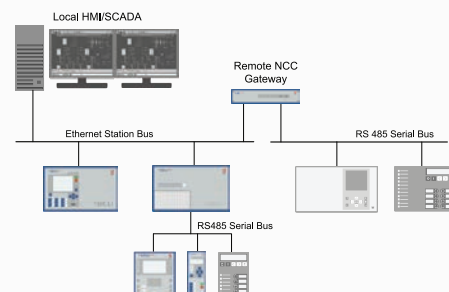
Economical Distributed Automation Systems

- Local HMI/SCADA
- Integrated protection and control
- RSTP ring architecture with IED built-in switches for station bus



Conventional Substation Automation

- Combination of Ethernet, hardwiring and serial-based communication
- Optimal for system expansions or retrofits
- Multiple serial protocols available



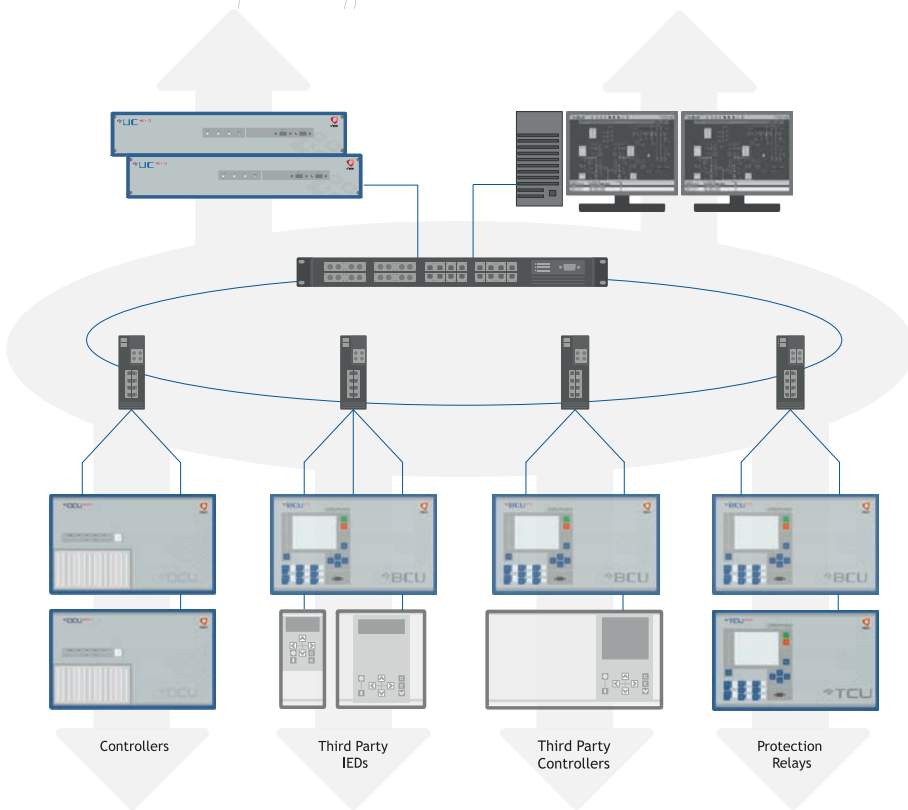
Designed for Communication and Integration

CLP 500SAS solutions are designed to communicate and integrate. The availability of IEC 61850 as one of the main station communication solutions provides full compatibility at both communication and engineering levels. Fine-tuned design with regard to GOOSE messaging allows sophisticated distributed protection, automation and control architectures to be deployed with full confidence and reliability.

The CLP 500SAS platform is also ready to support future IEC 61850 Ed.2 requirements such as enhanced engineering support, high-precision network time synchronization and synchronized sampled values for station and process bus applications, as well as IEC 61850-based wide-area communications for protection and control as well as operation and maintenance.

Enhanced communications with real-time Ethernet are complemented with over 50 different serial or IP communication protocols including IEC 60870-5, DNP, OPC, Profibus and Modbus. This enables the integration of any controller, protection relay or measurement unit for both real-time monitoring and control, condition monitoring and diagnostics, as well as for non-real-time data extraction and storage such as sequence of events or disturbance records.

Multiple serial or IP channels and redundant links with simultaneous multi-protocol support enable straightforward connection with any remote control, dispatching or maintenance and asset management centers.



Cyber-security

As systems become more interconnected with higher levels of information sharing and control through interoperable solutions based on open standards such as standard Ethernet and TCP/IP technologies, the exposure of the substation to cyber-security threats increases.

Understanding that there is a balance between reliability and cyber security, **CLP 500SAS** can be deployed with security-enabled products and architectures, and also with engineering processes and procedures according to security regulations and standards. The availability of selected secure protocols, role-based access control or auditing features in **CLP 500SAS** products together with firewall/router/VPN technologies enables the deployment of distinct security solutions including network architectures, single or multiple security boundaries, DMZ and security management, according to specific system requirements and associated security risk assessment.

Systems Integration

Since substation automation is not an off-the-shelf product, Efacec solutions offer the flexibility to meet the demands of each individual system. This means not only the adaptable technology of its own product portfolio, independently certified and user approved, but also combination of third party offer or the provision of certified cabinets and enclosures. One example is the **CSC 5000** range of control system cabinets, including protection and control devices, communication equipment, electrification and power supply.

Lifecycle Support






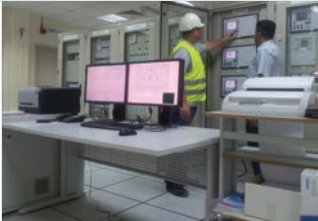


Behind an easy to use and optimized solution lies an increasingly complex substation automation system with multiple aspects that require adequate management. Efacec is a unique solutions provider with experience, expertise and adaptability that customers rely on to deliver the best fitting solution for their needs.

Ranging from systems specification and design, through integration, commissioning and training, up to maintenance and product support, Efacec provides a full set of engineering services throughout your value chain.

Efacec services, delivered worldwide by engineering and customer support teams with highly experienced and certified professionals and project managers, are custom-fitted to each customer and ensure system deployment on-spec, on-time and on-budget as well as readily available support during system operation.

By combining proven engineering know-how with large experience in modern digital control systems and communications, Efacec solutions allow users to benefit from a complete automation solution in full reliability and confidence, while safeguarding investment for the future.



Case Studies		
Location / Company	Overview	Example
Ermesinde 220/60 kV Substation		
Portugal / REN 	<p>Efacec Automation provided REN an open and flexible automation system based on the CLP 500SAS platform for the Ermesinde Substation. The project consisted in implementation of protection and control systems in 18 bays including line, transformer and busbar for 60 and 220 kV, and also capacitor bank bays for power factor correction. The system is a unique example of a multi-vendor IEC 61850 solution combining three different IED manufacturers.</p> <p>Efacec Automation cooperates closely with REN for over 25 years, have supplied dozens of SAS systems for new, remodeled or expanded substations, with voltage levels up to 400 kV.</p>	
Several 220/60 and 60/30 kV Substations		
Algeria / SONELGAZ 	<p>Efacec Automation provided Algerian utility with substation automation systems (SAS) for several transmission and distribution substations. The SAS, based on CLP 500SAS platform, integrates Efacec UC 500E station servers, BCU 500 bay control units, TPU 420 relays, as well as IED from third parties.</p> <p>With these installations SONELGAZ benefits with improved and more reliable systems that consequently optimizes network operation.</p>	
Several 220/66/11 kV Substations		
Bahrain / EWA 	<p>Efacec Automation products and solutions are highly recognized by Electricity and Water Authority of Bahrain, as we have provided to date nearly 30 integrated control systems (ICS) based on CLP 500SAS as well as several ongoing projects. These ICS integrates Efacec UC 500E station servers, BCU 500 bay control units and protection relays from third parties.</p>	
Romio 132/50 kV Substation		
Spain / HC ENERGIA 	<p>Efacec Automation provided Spanish HC ENERGIA's Romio Substation with an automation system, featuring protection and control. The installed CLP 500SAS platform integrates Efacec BCU 500, as well as IED from third parties. The communication integration of all devices is performed over protocols such as Modbus, IEC 60870-5-104 and IEC 61850 standard.</p>	



Automation Business Unit

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