Digital Substation Automation Systems

Unified Solution CLP 500

IEC 61131-3 flexible programming

IEC 61850 open design

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 edition of **CLP 500SAS** digital automation platform for substation automation 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, HMI and system management 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 including station bus architectures or full process-bus digital solutions. Depending on requirements compact and economical solutions or full featured high-performance decentralized systems can be implemented, including different levels of functional integration, redundancy and communication integration.

By adopting the latest 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 and management 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 PRP/HSR or RSTP redundancy options and open engineering
- Multiple standard communication protocols and I/O options
- Modular, scalable and secure architecture with multiple redundancy options
- Extended range of IEDs from transmission to distribution
- Multiple HMI options including secure external mobile and web access
- IEC 61131-3 user programmability
- Unified system engineering and management tools from programming to HMI design
- Strict conformance to industry standards
- Support for process bus fully digital 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 and maintenance efforts
- Seamless integration with third party products and systems
- Low total cost of ownership without compromising reliability

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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 digital 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 digital substation automation becomes integrated grid automation.

Protection & Control 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 or IEC 61850-9-2 SV, **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, PTP, 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 CLP 500SAS Products	
Series 500 IED 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.
Series 450 IED Protection, Automation and Control	The **Series 450** protection and control relays were designed for sub-transmission and distribution applications, offering a range of fast, reliable and field-proven protection functions combined with control, measurement and monitoring. This product is available in three variants, allowing users to choose the best solution for each application scheme.
Series 430 IED Protection, Automation and Control	The **TPU 430** protection and control relays are a cost-effective secure solution for line/feeder and capacitor bank protection as well as backup or auxiliary protection and control for transformers, generators, and other assets in HV/MV systems.
Series 420 IED 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.
Series 220 IED Protection, Automation and Control	The **Series 220** compact protection relays and controllers are a cost-effective secure solution for line/feeder protection, recloser and sectionalizer control, renewable plant control, as well as backup or auxiliary protection and control for transformers, generators and motors in HV/MV systems.
HMI 500 Station SCADA/HMI	Substation SCADA software featuring full vector graphics, alarms, historian, trending, statistics and reporting including full-featured web-based HMI.
HMI 500TOUCH HMI Console	Local HMI consoles featuring multiple display options including touch-screens.
UC 500 Station 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.
Automation Studio SYSTEM POINT System Management	Developed specifically for the substation, system management software from Efacec integrates operational data management and system management while providing a vendor-neutral solution based on utility standards such as IEC 61850 and IEC 62351.
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 protection, automation and control devices 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 and process bus using state-of-the-art PRP is also supported across the product line (HSR option available in selected products), ensuring full system availability in the presence of any communication component failure. This enables customers to benefit from the value and flexibility of distributed digital systems while maintaining the high reliability level of conventional hardwired architectures.

Unified Engineering and Management 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.

Furthermore, system management software allows users to deploy unified systems and data management across the utility infrastructure, enabling end-users to manage their substation automation assets effortlessly, while remaining focused on grid and grid asset operation. Features include handling of disturbances, faults, logs and events, device status and version, cybersecurity events/data and user management.

Adopt the Best Fitting Architecture

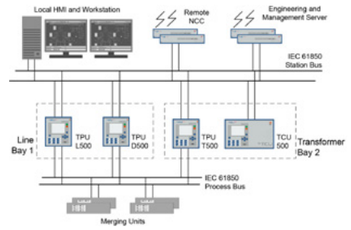
CLP 500SAS supports multiple system architectures from conventional serial and hardwired systems, through IEC 60870-5-104 distributed buses to fully-compliant IEC 61850 systems, including peer-to-peer communication capabilities, protected by redundancy protocols such as RTSP or PRP/HSR and process bus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

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

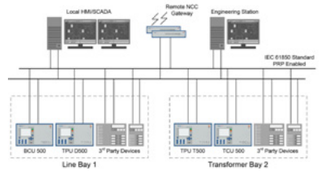
IEC 61850 Digital Transmission Substation Automation

- Local HMI/SCADA and System Management
- Main 1 / Main 2 integrated protection and control philosophy
- Multi-vendor integration
- PRP-enabled station and process bus architecture



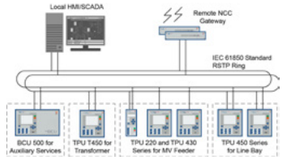
IEC 61850 Transmission Substation Automation

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



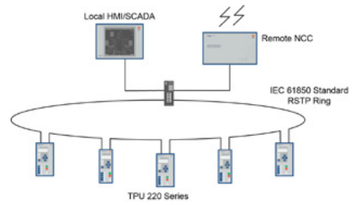
IEC 61850 Distribution / Sub-transmission Substation Automation

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



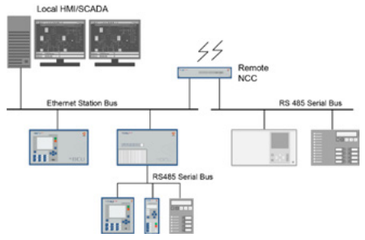
Economical Distributed Automation Systems

- 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



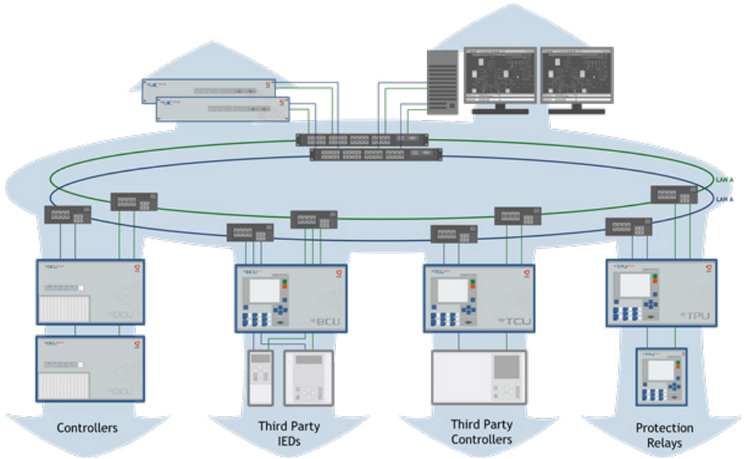
Designed for Communication and Integration

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 and sampled value messaging allows sophisticated distributed protection, automation and control architectures to be deployed with full confidence and reliability.

The **CLP 500SAS** platform also supports the latest IEC 61850 edition 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.



Open system design with IEC 61850

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 technology 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
Jvari 500/220/10 kV Transmission Substation		
Georgia - GSE	Efacec Automation is providing the SAS, featuring protection and control, for 500 kV transmission substation in Georgia. The system includes CLP 500SAS platform, the unified solution for substation automation, integrating the Efacec automation products, such as stations servers, HMI and bay controllers, with protection relays from other parties. Overall equipment integration is according to the latest edition of IEC 61850 standard, and communications with the remote SCADA carried out through the IEC standard protocols.	
Several 132, 66, 33 and 11 kV Substations		
Kenya - KENYA POWER	Efacec Automation supplied Kenya Power with the CLP 500SAS, based on technology integrally developed by Efacec. This solution was deployed in several transmission and distribution substations, with voltage levels of 132, 66, 33 and 11 kV. The installed SAS integrates bay control units and terminal protection units from Efacec, as well as third party protection relays and measurement devices. The solution is based on IEC 61850 standard, using GOOSE and MMS protocols.	
Ermesinde 220/60 kV Substation		
Portugal / REN	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. Efacec Automation cooperates closely with REN for over 25 years, having supplied dozens of SAS systems for new, remodeled or expanded substations, with voltage levels up to 400 kV.	
Several 220/60 and 60/30 kV Substations		
Algeria / SONELGAZ	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 station servers, bay control units, and protection relays, in addition to other IED from third parties. With these installations SONELGAZ benefits with improved and more reliable systems that consequently optimizes network operation.	
Several 220/66/11 kV Substations		
Bahrain / EWA	Efacec Automation products and solutions are highly recognized by Electricity and Water Authority of Bahrain, as we have provided over 50 integrated control systems (ICS) based on CLP 500SAS as well as several ongoing projects. These ICS integrates Efacec embedded station servers, bay control units, in addition to protection relays from third parties	
Romio 132/50 kV Substation		
Spain / HC ENERGIA	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.	

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