

Series 500 Automation and Control IED

Overview

The series 500 IED fully address the most demanding applications, such as utility transmission and distribution systems, power plants, transportation or industrial applications, by combining diverse I/O options, advanced user-programming and high-performing control in a highly reliable, flexible and powerful device platform.

Object orientation and state-of-the-art toolset allow straightforward engineering throughout the system life-cycle without compromising user requirements. Designed with IEC 61850 and other open standards in mind the series 500 products are future-proof and can be seamlessly integrated in multivendor distributed systems.



Product Overview	
<p>DCU 500 Programmable Automation Controller</p>	High-capacity I/O programmable controller or remote terminal unit for highly demanding standalone or distributed applications.
<p>DCU 500H Programmable Automation Controller</p>	High-availability variant of the DCU 500, featuring hot swappable power supplies and redundant CPUs.
<p>BCU 500 Bay Controller</p>	Utility transmission and sub-transmission bay control unit featuring protection-related functions.
<p>TCU 500 Transformer Controller</p>	Transformer control unit featuring voltage regulation and tap changer control.



Key Features

- Multiple Communication Options
- Distributed Automation According to IEC 61850
- RSTP or PRP Communication Redundancy Options
- IEC 61131-3 PLC Programming
- Built-in Control and Protection Functions
- Watchdog and Self-monitoring
- Web-based Interface
- Redundant and Hot Swappable Hardware Options
- Full-colour HMI Option

Customer Benefits

- Single High-performing Platform
- Integrated Automation, Protection, Measurement and Recording
- Highly Adaptable
- Easy to Specify, Configure, Test and Maintain
- Flexible I/O Configurations
- Architecture prepared for future IEC 61850 Ed.2 including process bus



Open Automation

Enhanced Programming

The 500 series provides high-speed processors and large memory capacity for application of extensive user-defined algorithms programmed in IEC 61131-3. Boolean, integer and floating point logic and arithmetic is available together with the full range of standard function blocks including flip-flops, counters or timers.

The optimized logic engine supports prioritized cyclic and multi-event scheduling to meet diverse functional needs. Since all signals, either from communications, I/O, HMI, diagnostics or built-in functions, can be fed to and from the logic engine, the user has the ability to adapt the device to any specific requirement.

Integrated Engineering

Engineering is fully integrated in the Automation Studio toolset whether a device oriented or a distributed control system approach is required. While being highly adaptable products, configuration and maintenance efforts are reduced with features like templates, libraries, copy-paste or drag-and-drop.

Automation Studio is a unique easy to use environment providing a range of features from matrix and diagram editors to simulation and online device monitoring as well as data extraction and analysis.

These features are complemented with unified project system integration, comparison and productivity wizards or import/export including IEC 61850 SCL that make enhanced system functions simple to setup, visualize and manage.

Distributed Applications

The IED 500 family products were designed with IEC 61850 in mind in every aspect and thereby provide open system design and full compatibility with other compliant devices, engineering tools and systems.

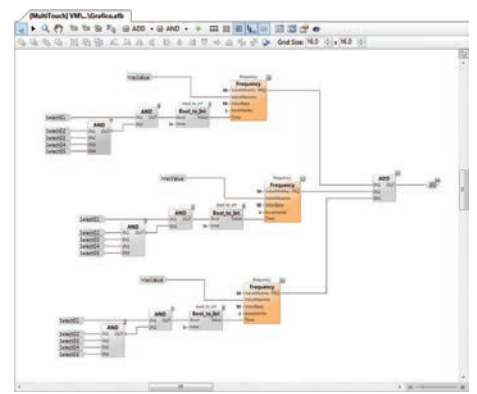
Functions, built-in or user-defined, are object-oriented and provide algorithm encapsulation through data point inputs and outputs. This approach allows simplified adoption of modern object-oriented engineering approaches such as IEC 61850. The user may fully define the logical node classes and logical device allocation in each configuration providing unmatched logical configuration capabilities.

Fine-tuned communication performance with regard to GOOSE messaging allows sophisticated distributed automation architectures to be deployed with full confidence and reliability.

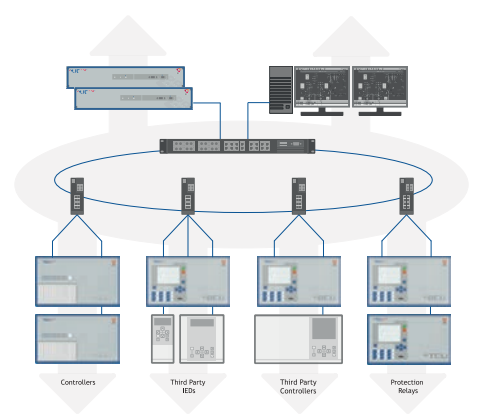
Options of built-in dual Ethernet interface, RSTP or PRP enables the system architect to integrate 500 series devices on different station bus redundancy architectures.

The IED 500 core platform is also ready to support future IEC 61850 requirements such as high precision synchronization and synchronized sampled values for process bus applications in upcoming hardware editions.

```
PLC700VMPNo_GEL_Txt
1 [using System]
2 #DEFINE_SOME=NOT (T002_0Tval) and T002_0 = Quality.Good OR NOT (T002_0Tval) and T002_0
Quality.Good) ;
3
4 /* To enter isolate run pass on alarmloop */
5 IF Cond_Isolamento and Cond_Isolamento_Quality.Good THEN
6 #DEFINE_SOME=false;
7 END_IF;
8
9 IF NOT_Q01=INT#2 ("Q0pos_OFF") and NOT_Q1=INT#2 ("Q0pos_OFF") and NOT_Q1=INT#2
("Q0pos_OFF") and (NOT_Q1=false ("Q0pos_OFF") OR NOT_Q1=false ("Q0pos_OFF")) then
10 NOT_Q1=INT#2 ("Q1pos_OFF");
11 else
12 NOT_Q1=INT#2 ("Q1pos_OFF");
13 end_if;
14
15 IF NOT_Q1=INT#2 ("Q0pos_OFF") and NOT_Q1=INT#2 ("Q0pos_OFF") and NOT_Q1=INT#2
("Q0pos_OFF") then
16 #DEFINE_SOME=true;
17 end_if;
18
19 TON(Tval,T#3);
20 contador=0;
21
22 IF contador=0 then
23 IF false then
24 NOT_Q1=INT#2 ("Q1pos_OFF");
25 contador=contador+1;
26 else
27 NOT_Q1=INT#2 ("Q1pos_OFF");
28 contador=contador+1;
29 end_if;
30
31 end_if;
32
```



IEC 61131-3 Programming



Fully-integrated IEC 61850 Automation Systems

User and Process Interface

User Interface Options

The local interface (BCU 500 and TCU 500 only) includes an optional bright high-contrast colour LCD, 16 programmable alarms, keypad and 8 function keys. DCU 500 and DCU 500H provide a LED-based I/O status interface.

The local LCD may display multiple mimic pages that, together with the menu/window system, provide access to all functions running on the device, including operation and control, monitoring, management of operational settings, setting groups and operating modes, recent events, etc.

Complementary to the local interface and toolset, an embedded webserver is available at the front or rear Ethernet ports providing access to all local operations as well as to trend, fault or disturbance data. This allows interaction with the device and associated process locally or remotely without requiring external software tools.

User Interface	BCU 500	TCU 500	DCU 500	DCU 500H
Colour LCD 5.7"	○	○		
Programmable Alarm / Indication LED	●	●		
Functional Keys	●	●		
IED Status LED			●	
Digital I/O Status LED				●
Integrated Webserver			●	

- - Base feature
- - Optional feature

Versatile Local I/O Options

Both pre-defined and fully specifiable I/O module configurations are available, allowing the 500 series devices to match the specific requirements of each application.

The DCU 500 and DCU 500H offer field-replaceable modules for enhanced flexibility whereas the BCU 500 and TCU 500 provide factory assembled options for product standardization.

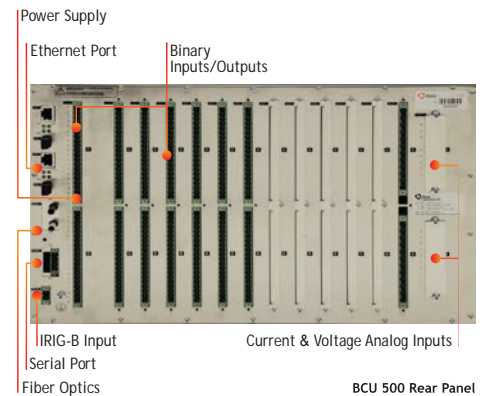
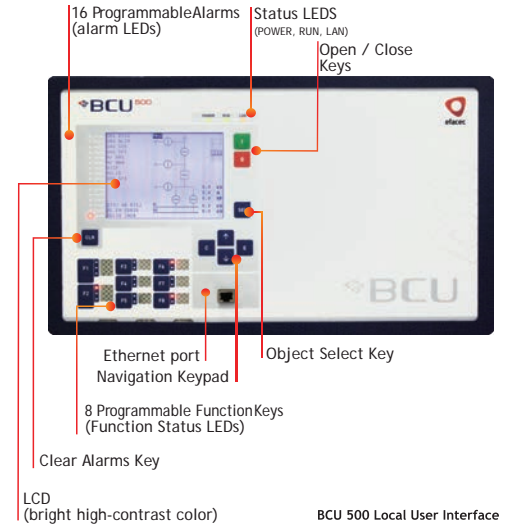
Data Acquisition Modules

Data acquisition modules support low-level processing of single, double, n-bits, pulse counting for binary I/O data and filtering for analogue data.

Analogue AC current and voltage inputs, available at the BCU 500 and TCU 500, also include internal channel summation, selection and compensation which allow the application of multiple CT/VT arrangements without additional external hardware.

I/O Options	BCU 500	TCU 500	DCU 500	DCU 500H
I/O Limits	Chassis Configuration		1	2
Maximum Digital I/O Points* (inputs/outputs)			264/136	256/128
Maximum Analogue DC Inputs*			32	32
Maximum Analogue AC Inputs	12	24		0
Base I/O				
8 DI + 8 DO			●	
I/O Expansion Card Types				
Digital I/O Expansion Cards (up to 8)				
16 DI Expansion Card				
32 DI Expansion Card				
8 DI + 8 DO Expansion Card				
16 DI + 8 DO Expansion Card	12	10		12
16 DO Expansion Card				
8 Fast DO Expansion Card				
DC Analogue Inputs Expansion Cards (up to 4)				
8 DC Analogue Inputs Expansion Card				
AC Analogue Inputs Expansion Cards				
8 AC Analogue Inputs Expansion Card**	1	2		0
12 AC Analogue Inputs Expansion Card**				

- - Base feature
- * Non-simultaneous inputs and outputs
- ** Sensitive current input options are available for earth fault protection functions



Extended Communication Capabilities

In parallel with IEC 61850 capabilities each device can also be used as a multiprotocol communication master and/or slave station. Standard protocols like IEC 60870-5-101/104, DNP 3.0, IEC 60870-5-103 or Modbus are available.

Integration of other monitoring devices, retrofits, multivendor systems and future expansions are hence made simple with certified implementations of IEC 61850 as well as other open communication protocols that convey a high degree of integration and interoperability to the whole product family.

Time Synchronization

Real-time clock synchronization can be performed via SNTP, IRIG-B, by communication protocol or set at the local interface.

Built-in Functions

Recording

The general purpose event recorder with millisecond or better precision can store at least 25000 events of any data source.

The disturbance recorder can be configured according to complex trigger options such as trips, analogue channel supervision or any user-defined logic. Disturbance files are stored in native COMTRADE format and include both analogue and digital information.

In addition to event and disturbance recorders a general purpose statistical trend recorder is available to generate load diagrams or similar trend data. All data is kept in non-volatile memory and FTP protocol is also available for data access.

Measurement and Metering

Accurate measurement of magnitude, angle, power, energy, impedance and frequency for three-phase systems or other non-phase related current and voltage signals is available.



Time	Name	Start Date	End Date	Value
2010-09-03 14:49:29.24	CTRL_AGR_AGR7	2010-09-03 14:49:29.24	2010-09-03 14:49:29.24	Ok
2010-09-03 14:49:29.231	IC_SLA_AGR7_Out	2010-09-03 14:49:29.231	2010-09-03 14:49:29.231	1
2010-09-03 14:49:29.214	IC_SLA_AGR7_Out	2010-09-03 14:49:29.214	2010-09-03 14:49:29.214	1
2010-09-03 14:49:29.254	APR_CB01_Protect	2010-09-03 14:49:29.254	2010-09-03 14:49:29.254	1
2010-09-03 14:49:29.238	CTRL_AGR_AGR7	2010-09-03 14:49:29.238	2010-09-03 14:49:29.238	Alarm
2010-09-03 14:49:29.231	IC_SLA_AGR7_Out	2010-09-03 14:49:29.231	2010-09-03 14:49:29.231	1
2010-09-03 14:49:29.214	IC_SLA_AGR7_Out	2010-09-03 14:49:29.214	2010-09-03 14:49:29.214	1
2010-09-03 14:49:29.368	CTRL_VREGSI_AGR5	2010-09-03 14:49:29.368	2010-09-03 14:49:29.368	Automatic de Mandre 0/0
2010-09-03 14:49:29.332	APR_CB01_Protect	2010-09-03 14:49:29.332	2010-09-03 14:49:29.332	1
2010-09-03 14:49:27.411	GOOSE #1 Failure	2010-09-03 14:49:27.411	2010-09-03 14:49:27.411	Good
2010-09-03 14:49:27.411	GOOSE #1 Failure	2010-09-03 14:49:27.411	2010-09-03 14:49:27.411	Good
2010-09-03 14:49:27.382	GOOSE #1 Failure	2010-09-03 14:49:27.382	2010-09-03 14:49:27.382	Good
2010-09-03 14:49:27.371	GOOSE #1 Failure	2010-09-03 14:49:27.371	2010-09-03 14:49:27.371	Good
2010-09-03 14:49:28.371	APR_Synch1_AutoRelease	2010-09-03 14:49:28.371	2010-09-03 14:49:28.371	Manual Operation Synch
2010-09-03 14:49:28.371	APR_Synch1_AutoRelease	2010-09-03 14:49:28.371	2010-09-03 14:49:28.371	Manual Operation Synch

Data Records

Communication Interfaces	
Service/Engineering (Front Panel)	
10/100BASE-TX	●
Operation or Service/Engineering (Rear Panel)	
RS232/RS485, Plastic Fibre or Glass Fibre	●
RS232/RS485, Plastic Fibre or Glass Fibre	○
RS232/RS485, Plastic Fibre or Glass Fibre	○
Dual 10/100BASE-TX or Dual 100BASE-FX	○
Dual PRP-enabled 10/100BASE-TX or 100BASE-FX and additional single 10/100BASE-TX or 100BASE-FX	○
Dual RSTP-enabled 10/100BASE-TX or 100BASE-FX and additional single 10/100BASE-TX or 100BASE-FX	○
Time Synchronization	
IRIG-B (Requires IRIG-B input)	○
SNTP Client	●
By Communication Protocol	●
IEC 61850	
IEC 61850 Server and GOOSE	●*
Communication Protocols (Slaves/ Servers)	
IEC 60870-5-104 (TCP/IP)	○
IEC 60870-5-101 (Serial)	○
IEC 60870-5-103 (Serial)	○
DNP 3.0 (Serial or TCP/IP)	○
MODBUS (Serial or TCP/IP)	○
Others (Please Contact)	○
Communication Protocols (Masters/ Clients)	
IEC 60870-5-101 (Serial)	○
IEC 60870-5-103 (Serial)	○
Courier (Serial)	○
DNP 3.0 (Serial or TCP/IP)	○
MODBUS (Serial or TCP/IP)	○
Others (Please Contact)	○

- - Base feature
- - Optional feature
- * - Optional feature for DCU 500 and DCU 500H

Built-in Functions

Control and Supervision Functions

In both **BCU 500** and **TCU 500** selectable firmware functions allow control and supervision of up to 30 circuit breakers and switches with optional synchronism-check. Secondary system supervision functions such as of instrument transformers or trip circuits are included.

Control functions feature direct or select-before-operate controls, secure hardwired or distributed interlocking and multi-level authority sources.

Protection Functions

A set of complementary built-in protection functions is also available in both **BCU 500** and **TCU 500**, such as current, voltage and frequency functions.

Transformer Control Functions

The **TCU 500** combines voltage regulation and tap changer control with functions such as fan and pump control and protection supervision (Buchholz, overpressure, temperature monitoring, among others).

Voltage regulation provides control of voltage in any winding for up to 6 transformers in parallel with multiple **TCU 500** units. It can be applied on two or three winding transformers (with priority winding selection). Operation of multiple transformers is based on circulating current minimization or master/slave control.

Line drop compensation, supervision of tap changer operation and a two time constant thermal overload replica are also available.



Functions						
Protection	ANSI	BCU 500	TCU 500	DCU 500	DCU 500H	IEC 61850
(Directional) Phase Overcurrent (Optional Directionality)	50/51/67	● 6	● 3			PTOC/RDIR
(Directional) Earth-Fault Overcurrent (Optional Directionality)	50N/51N/67N	● 6	● 5			PTOC/RDIR
Thermal Overload	49		● 1			PTTR
Phase Overvoltage	59	● 3	● 3			PTOV
Residual Overvoltage	59N	● 3	● 3			PTOV
Phase Undervoltage	27	● 3	● 3			PTUV
Underfrequency	81	● 3	● 1			PTUF
Overfrequency	81	● 3	● 1			PTOF
Frequency Rate-of-Change	81	● 3	● 1			PFRC

● - Base feature

(n) - Maximum number of available functions

Functions						
Control and Supervision	ANSI	BCU 500	TCU 500	DCU 500	DCU 500H	IEC 61850
Automatic Reclosing	79	● 6				RREC
Synchronism and Voltage Check	25	● 6	● 5			RSYN
Circuit Breaker Failure	51BF	● 6	● 5			RBRF
Trip Circuit Supervision	74TC	● 6	● 5			STRC
Circuit Breaker Close / Lockout	86	● 6	● 1			RCBL
Automatic Voltage Control	90		● 1			ATCC
Fuse Failure / VT Supervision		● 3	● 3			RVTS
CT Supervision		● 6	● 5			RCTS
Circuit Breaker Control / Supervision	52	● 6	● 5	● 12	● 12	CSWI / XCBR
Circuit Switch Control / Supervision	89	● 24	● 24	● 32	● 32	CSWI / XSWI
Tap Changer Control / Supervision			● 1			YLTC
Transformer Pump and Fan Control / Supervision			● 1			CCGR
Transformer Protection Supervision			● 1			SPTR
Distributed Automation		●	●	●	●	GGIO <small>(or user defined)</small>
Programmable Automation (IEC 61131-3)		●	●	●	●	GAPC <small>(or user defined)</small>
Monitoring	ANSI	BCU 500	TCU 500	DCU 500	DCU 500H	IEC 61850
Three-Phase Accurate Measurements		● 6	● 3			MMXU / MSQI
Single-Phase Accurate Measurements		● 6	● 3			MMXN
Metering		● 6	● 3			MMTR
Current / Voltage Disturbance Recorder		●	●			RDRE
Chronological Event Log		●	●	●	●	
Load Diagram / Statistical Trend Recorder		●	●	●	●	
Self-Tests and Watchdog		●	●	●	●	

Platform Options						
Availability Options		BCU 500	TCU 500	DCU 500	DCU 500H	
Hardware Watchdog and Auto-reset (Detection of hardware and RTOS failures)		●	●	●	●	
Software Failure Detection and Recovery (Self-healing of software module failures)		●	●	●	●	
High-availability Configuration (Hot-pluggable Power Supply and Dual-CPU)					●	
Second CPU Card					○	
Second Power Supply		○	○		●	
Power Supply Options						
24/48/60 V d.c. (19 V to 60 V)						
48/60/110/125 V d.c. (38 V to 150 V)		○	○			
110/125/220 V d.c. (88 V to 350 V) 115/230 V a.c. (80 V to 265 V)				○	○	

● - Base feature

○ - Optional feature

(n) Maximum number of available functions

Device Platform

Platform Overview

The 500 series products are rack-mountable and based on a common platform featuring high-performance hardware and modular software.

The multiprocessor architecture and optimized design ensure the availability of processing power for all active functions. This common platform simplifies all engineering procedures from specification to commissioning as well as operation and maintenance by reducing the learning curve and leveraging know-how.

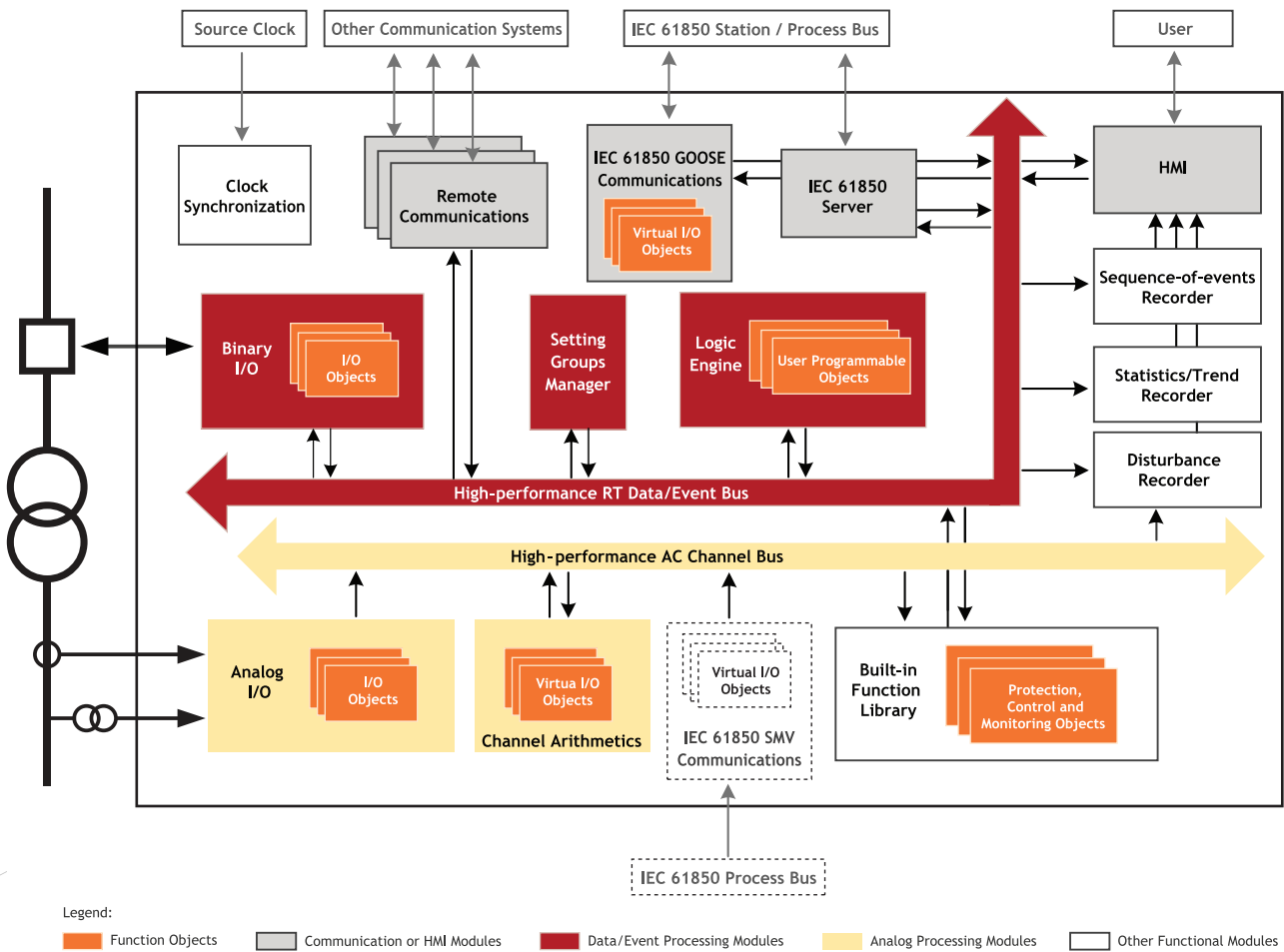
High-availability Options

The series 500 devices support power supply redundancy as an option and the DCU 500H offers a high-availability configuration with hot-pluggable dual power supplies, CPUs and communication cards, as well as field-replaceable I/O cards. In this configuration user programs and other device functions operate in bumpless mode ensuring no program control steps are lost in case of CPU failover.

DCU 500H devices are programmed as single CPU devices ensuring no additional engineering cost is required in such applications.

Self-diagnostics

Self-diagnosis includes watchdog, watchdog output, self-tests and supervision of all hardware components, including memory, I/O cards and communication ports, and of all built-in software modules. A test mode, suitable to validate device operation, can also be set.



Example Applications

Application Overview

The 500 series platform enables unprecedented balance between cost, performance and adaptability to user requirements in high demanding applications. The modular architecture, object-oriented function design, powerful user programming and free allocation of functions enable the deployment of both complex distributed architectures and standalone configurations.

Product and Life-cycle Support

The openness of series 500 family and the support throughout the life-cycle ensure future-proof technology and allow stepwise investment strategies. Efacec also provides a full range of services from training and support to engineering and maintenance that ensures you have products best fit for your requirements.



Example Application Description		
<p>BCU 500</p> <ul style="list-style-type: none"> • Double breaker or breaker-and-a-half topologies • Complex user-defined automation schemes and distributed automation • Synchronism-check included • Multi-bay control in one single device • Control functions, including load shedding and restoration 		
<p>TCU 500</p> <ul style="list-style-type: none"> • Voltage regulation for up to 6 transformers in parallel • Minimization of circulating current or master/slave control • Complete control and supervision of each transformer bay • Control and supervision of tap-changers • Voltage regulation for three-windings transformers, with priority voltage level • Information exchange between different voltage regulators • Optional line drop compensation 		
<p>DCU 500</p> <ul style="list-style-type: none"> • Remote terminal unit • High I/O capacity • User programmability • Remote terminal unit • Integration of third party devices • Multiple protocol support 		
<p>DCU 500H</p> <ul style="list-style-type: none"> • Programmable automation controller for power plant distributed control systems • High availability hardware 		



Automation Business Unit

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