Protection and Control IEDS

Overview

Efacec delivers a full range of protection, automation and control products developed in-house by highly experienced teams combining state-of-the-art technology with innovation in accordance with industry standards.

The IED portfolio includes Series 500, 450, 430 and 220, enabling reliable, flexible and powerful protection and control for applications ranging from power transmission to distribution and industry.

Drawing on the experience obtained with years of field-proven protection applications, a careful design of functions, hardware and portfolio segmentation provides customers with application-focused performance, reliability and cost.

Efacec function and device architecture 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 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.

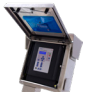
Efacec has a long tradition of effectively and efficiently combining Efacec-own relays and controllers with third-party products to provide reliable solutions and has been an early adopter of standards such as IEC 60870, DNP and also IEC 61850. The latter is not integrated as an add-on protocol but architecturally supported by all the IED range therefore proving inherent support for distributed solutions as well as interoperability and openness from communication to information and engineering levels.

Key features

- Combined protection, control, measurement, monitoring and recording
- Compliant with state-of-the-art standards
- Fully customisable mimic diagram with local HMI
- IEC 61131-3 logic and PLC programming
- Compliant with IEEE C37.94 standard for remote end communication
- Multiple protocols supported
- RSTP or PRP/HSR communication redundancy options
- Designed according to the latest edition of IEC 61850
- IEC 61850-9-2 process bus
- Built-in cybersecurity
- Watchdog and self-monitoring
- Web-based interface
- Automation Studio toolset for engineering

Benefits

- Economical and secure P&C solution
- Easy to integrate into existing or new systems
- Easy to specify, configure, test and maintain
- Highly adaptable
- Cybersecurity for power grid protection
- Core IEC 61850 implementation for future-proof systems
- Unified high-performing platform

	Series 500 IEDs				Series 450 IEDs	Series 430 IEDs	Series 220 IEDs		
									
	TPU 500	BCU 500	TCU 500	DCU 500	TPU 450	TPU 430	TPU 220	RCU 220	DCU 220
	Protection & Control Relays	Bay Controller	Transformer Bay Controller	Programmable Automation Controller	Protection & Control Relays	Protection & Control Relays	Protection & Control Relays	Overhead Switchgear Controller	Control and Automation Unit
Typical application domain									
Transmission	•	•	•	•					
Sub-transmission	•	•	•	•	•				
Distribution				•	•	•	•	•	•
Industrial				•		•	•		•
Main functions									
Single/three pole trip	•	•						•	
Three-pole trip			•		•	•	•		•
Multi-breaker arrangements	•	•	•						
Hardware features									
Binary inputs (max, non-simult.)	264	264	264	392	104	104	24	32	176
Binary outputs (max, non-simult.)	135	135	135	199	55	56	24	16	40
Fast digital outputs	•	•	•						
Analogue DC inputs (max, non-simult.)	32	32	32	40	8	8	8		18
RTD inputs (max)	(*)	32*	32*	32*	8*	8*	8*	2	10
Analogue DC outputs (max)				8		2*	2*		2
Analogue AC inputs (max)	24	24	24		12	12	4/8	10	32
Sensors (LPIT/NCIT)						(*)	(*)	6	
Case width (x 19")	1 or 1/2	1 or 1/2	1 or 1/2	1	1/2	1/2	1/3	1/3	1 or 1/2
Case height	6U	6U	6U	6U	6U	6U	6U	6U	6U
Alphanumeric display (columns x lines)	20x4						20x4	20x4 (detach.)	20x4 (detach.)
Graphical display	5.7"	5.7"	5.7"		5.7"	5.7"			
Programmable alarms /Indication LED	16	16	16		16	16	8	8	12
User-defined function keys	9	9	9		9	9	3	6	6
Communication interfaces									
Serial ports (232/485)	3	3	3	3	3	2	2	2	2
System Ethernet interfaces	3 or 6	3 or 6	3 or 6	3	3	1 or 2	1 or 2	1 or 2	1 or 2
Teleprotection (IEEE C37.94)	4 channels				2 channels				
GPRS								•	•
PRP/HSR station bus	•	•	•	•	•	•(**)	• (**)		
RSTP station bus	•	•	•	•	•	•	•		
PRP/HSR Process bus	•	•	•						
IRIG-B	•	•	•	•	•	•	•	•	•
PTP (IEEE 1588:2008)	•	•	•	•	•	•	•		
Communication protocols									
Integrated webserver	•	•	•	•	•	•	•	•	•
IEC 61850 server and GOOSE	S	S+C	S+C	S+C	S	S	S	S	S
IEC 60870-5-101/104/103	•	•	•	•	S	S	S	S	•
DNP 3.0	•	•	•	•	S	S	S	S	•
Modbus	•	•	•	•	S	S	S	C (*)	•
Courier	C	C	C	C					C
Others (please contact)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)

(*) Currently under development | (**) HSR under development | S - Server/Slave | C - Client/Master | • - Both/available

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Series 500 - Transmission and Sub-Transmission Protection and Control

The **Series 500** 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.

Series 500 is fully prepared to support modern fully digital substation solutions including third-party system engineering tool integration and process bus architectures with high-speed GOOSE and IEC 61850-9-2 sampled value subscription.

Part of this series, the **TPU 500** relays family fully addresses the needs of transmission and sub-transmission power system protection by offering fast, reliable and field-proven algorithms on a high performance hardware and software platform. Product options include protection functions for line, transformer, switchgear and other assets, featuring algorithms such as differential, distance, current, voltage and frequency together with control, supervision, recording and monitoring.

Product portfolio	
BCU 500 Bay Controller	Utility transmission and sub-transmission bay control unit featuring protection-related functions.
TCU 500 Transformer Controller	Transformer control unit featuring voltage regulation and tap changer control.
TPU T500 Transformer Protection	Protection of transformers, including two- or three-winding transformers, auto-transformers, shunt reactors or generator-transformer units.
TPU D500 Line Differential Protection	Protection of overhead lines and underground cables in transmission and sub-transmission networks.
TPU L500 Line Distance Protection	Distance protection, with quadrilateral and/or mho characteristics, used standalone or in a duplicated protection scheme.
DCU 500 Programmable Automation Controller	High-capacity I/O programmable controller or remote terminal unit for highly demanding standalone or distributed applications.

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Series 450 – Sub-Transmission and Distribution Protection and Control

The **Series 450** protection and control IEDs are designed for sub-transmission and distribution applications, offering a range of fast, reliable and field-proven protection functions combined with control, measurement and monitoring. The product is available in three variants, according to the main protection function, enabling the user to select the best solution for each application scheme.

Product range includes protection functions for line, transformer, switchgear and other assets, featuring algorithms such as differential, distance, current, voltage and frequency together with control, supervision, recording and monitoring.

High configurability via flexible digital and analogue I/O configurations, advanced user-programmable functions and a comprehensive library of selectable built-in firmware functions allow the user to adapt the device to different substation topologies, as well as distinct protection and control schemes. Full integration in the Automation Studio toolset allows straightforward engineering throughout the system life cycle without compromising user requirements.

Product portfolio	
TPU T450 Transformer Protection	Protection of two or three-winding transformers, auto-transformers, shunt reactors, among other grid assets.
TPU L450 Line Distance Protection	Protection for sub-transmission and high voltage overhead lines and underground cables, integrating a six-zone distance protection as main function.
TPU D450 Line Differential Protection	Protection for sub-transmission and high voltage overhead lines and underground cables, integrating a line differential protection for two line-end applications.

Series 430 – Multifunctional Protection and Control

The **TPU S430** protection and control relays provide 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. Arc flash detection is available as an option.

The TPU S430 are multifunctional relays that also allow plug-and-play engineering with fit-for-purpose configuration templates together with alternatives for customisation of protection schemes and user-defined PLC logic. Full integration in the Automation Studio toolset allows simple configuration, programming and management, either in standalone or system applications.

By fully supporting multiple open communication standards, it is both future-proof and integration friendly.

Product portfolio	
TPU S430 Multifunction Relay	Multi-functional line/feeder protection including current, voltage and frequency functions, together with synchro-check, fault locator, breaker failure, load shedding and user-defined logic.

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Series 220 – Distribution and Industrial Protection and Control

The **Series 220** compact protection relays and controllers are a cost-effective secure solution for line/feeder protection, recloser and sectionaliser control, renewable plant control, 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 alternatives for customisation of protection schemes and user-defined PLC logic. Full integration in the Automation Studio toolset allows simple configuration, programming and management, either in standalone or system applications. Arc flash detection is available as an opti

By fully supporting multiple open communication standards, it is both future-proof and integration friendly.

Product portfolio	
TPU S220 Multifunction Relay	Protection for line/feeder, including entry-level current functions, auto-reclosing and breaker failure, sensitive earth-fault protection and directionality, voltage and frequency functions, synchro-check and fault locator.
TPU B220 Voltage and Frequency Relay	Voltage and frequency relay, that includes voltage load shedding function, as well as optional frequency load shedding.
TPU M220 Motor Protection	Motor protection relay, with current and voltage functions, enabling supervision of machine faults, excessive load conditions and starting sequences under different operating modes.
RCU 220 Overhead Switchgear Controller	Recloser/sectionaliser controller that targets protection and control of distribution assets together with conventional RTU-functionality.
DCU 220 Control and Automation Unit	Designed for MV distribution networks and DER plants, can be applied as RTU for MV/LV transformer stations or plants, for small to medium I/O applications such as RMUs.

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Protection	ANSI	IEC 61850	Series 500					
			TPU T500	TPU D500	TPU L500	BCU 500	TCU 500	
Line differential (up to 5 line ends)	87L	PDIF / PHAR						
Line + transformer differential (up to 5 line ends)	87L/87T	PDIF / PHAR		■				
Line differential (up to 2 line ends)	87L	PDIF / PHAR						
Line + transformer differential (up to 2 line ends)	87L/87T	PDIF / PHAR						
(Auto-)transformer differential (2 windings)	87T	PDIF / PHAR	■					
(Auto-)transformer differential (2 or 3 windings)	87T	PDIF / PHAR						
Restricted earth fault	87N	PDIF	○					
Distance	21	PDIS	○	○	●			
Load encroachment and phase selection	21LE	PDIS	○	○	●			
Power swing blocking / out-of-step tripping	68/78	RPSB	○	○	○			
Distance teleprotection schemes	85(21)	PSCH		○	●			
Echo and weak end infeed logic - distance	85/27WI	PSCH		○	●			
Directional earth-fault teleprotection schemes	85(67N)	PSCH		●	●			
Echo and weak end infeed logic - directional earth fault	85/59NWI	PSCH		●	●			
Remote tripping	85	PSCH	●	●	●			
Stub	87STB	PDIF	○	○	○			
Phase overcurrent	50/51	PTOC						
(Directional) Phase overcurrent	50/51/67	PTOC / RDIR	●	●	●	●	●	
Earth-fault overcurrent	50N/51N 50G/51G	PTOC						
(Directional) Earth-fault overcurrent	50N/51N/67N 50G/51G/67G	PTOC / RDIR	●	●	●	●	●	
Negative sequence overcurrent	46	PTOC						
(Directional) Negative sequence overcurrent	46/67	PTOC / RDIR	●	●	●			
Editable time-current curves			●	●	●	●	●	
Inrush restraint	68	PHAR	●	●	●	●	●	
Cold load pickup		RCLP						
Hot line mode								
High current lockout	68	PIOC						
Thermal overload	49	PTTR	●	●	●		●	
Motor thermal overload	49M	PTTR						
Switch-onto-fault	50HS	RSOF / PIOC	●	●	●			
Arc flash detection	50L/50NL	SARC						
Current unbalance for capacitor banks	60C	PTOC						
Broken conductor check / phase unbalance	46BC	RBCD		●	●			
Undercurrent / loss of load	37	PTUC						
Load jam	51M	PTOC						
Motor supervision	48/51LR/66/14	PMSS, PMRI						
Directional earth-fault overcurrent for non-earthed systems	32N	PSDE		●	●			
Directional power	32	PDUP/PDOP		●	●			
Over / under power factor	55	POPF / PUPF						
Phase undervoltage	27	PTUV	●	●	●	●	●	
Phase overvoltage	59	PTOV	●	●	●	●	●	
Residual overvoltage	59N	PTOV	●	●	●	●	●	
Negative sequence overvoltage	47	PTOV	●	●	●			
Underfrequency	81U	PTUF	●	●	●	●	●	
Overfrequency	81O	PTOF	●	●	●	●	●	
Frequency rate-of-change	81RC	PFRC	●	●	●	●	●	
Overexcitation	24	PVPH	●					

• Base feature | ○ Optional feature, depends on order form | ■ Base mutual-exclusive feature, depends on order form | □ Optional mutual-exclusive feature, depends on order form | * Currently under development

	Series 450			Series 430		Series 220				
DCU 500	TPU T450	TPU D450	TPU L450	TPU S430	TPU S220	TPU B220	TPU M220	RCU 220	DCU 220	
		■								
	■									
	○			○						
			●							
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	○	●	●	●	○	●	○	○		
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	○	●	●	●	○	○	○	○		
	○	●	●	●	○	○	○	○		
	○*									

Control and supervision	ANSI	IEC 61850	Series 500					
			TPU T500	TPU D500	TPU L500	BCU 500	TCU 500	
Trip logic	94	PTRC	●	●	●			
Trip circuit supervision	74TC	STRC	●	●	●	●	●	
Circuit breaker failure	50BF	RBRF	●	●	●	○	●	
Fault indication								
Sectionaliser		RSEC						
Automatic reclosing	79	RREC		●	●	○		
Synchronism and voltage check	25	RSYN	○	○	○	●	●	
Voltage check	25	RSYN						
Circuit breaker close lock / lockout	86	RCBL	●	●	●	●	●	
Automatic loop restoration control								
Fuse failure / VT supervision	60	RVTS	●	●	●	●	●	
CT supervision		RCCS	●	●	●	●	●	
Open pole detector		ROPD		○	○	○		
Circuit breaker control / supervision	52	CSWI / XCBR	●	●	●	●	●	
Circuit breaker condition monitoring		SCBR	○	○	○	●	●	
Circuit switch control / supervision	89	CSWI / XSWI	○	○	○	●	●	
Automatic voltage control (single transformer)	90	ATCC					■	
Automatic voltage control (up to 8 transformers in parallel)	90	ATCC	○					
Tap changer control / supervision		YLTC	○				●	
Transformer pump and fan control / supervision		CCGR	●*				●*	
Transformer protection supervision	94T	SPTR	●				●	
Temperature supervision	26	STMP				○		
Power supply system supervision		ZBAT						
Distributed Automation		GGIO (or user defined)	●	●	●	●	●	
Programmable Automation (IEC 61131-3)		GAPC (or user defined)	●	●	●	●	●	
Monitoring, measurement and metering								
Three-phase measurements		MMXU / MSQI	●	●	●	●	●	
Single-phase measurements		MMXN	●	●	●	●	●	
Metering		MMTR	○	○	○	●	●	
Synchronised Phasors (PMU)		MMXU	●			●	●	
Statistics		MMXU (or user defined)	○	○	○	●	●	
Voltage variation (sags, swells and interruptions)		QVVR	○	○	○	●	●	
Harmonics		MHAI	○*	○*	○*	●*	●*	
Fault locator	21FL	RFLO		●	●			
Recording and reporting								
Disturbance recorder		RDRE	●	●	●	●	●	
Chronological event log / SOE			●	●	●	●	●	
Fault report			●	●	●			
Load diagram / Trend recorder			○	○	○	●	●	
Histogram			○*	○*	○*	●*	●*	
Power quality event recorder			○*	○*	○*	●*	●*	
Self-tests and watchdog			●	●	●	●	●	
Built-in cybersecurity								
Device hardening			●	●	●	●	●	
Onboard firewall			●	●	●	●	●	
DoS protection			●	●	●	●	●	
Secure communications with Engineering Tool			●	●	●	●	●	
Firmware integrity validation			●	●	●	●	●	
Role-Based Access Control (RBAC)			●	●	●	●	●	
Integration with central account management			●	●	●	●	●	
Password policies enforcement			●	●	●	●	●	
Security log/syslog client			●	●	●	●	●	
User Session Control			●	●	●	●	●	

• Base feature | ○ Optional feature, depends on order form | ■ Base mutual-exclusive feature, depends on order form | □ Optional mutual-exclusive feature, depends on order form | * Currently under development

	Series 450			Series 430	Series 220				
DCU 500	TPU T450	TPU D450	TPU L450	TPU S430	TPU S220	TPU B220	TPU M220	RCU 220	DCU 220
	●	●	●	●	●	●	●	○	
	●	●	●	●	●	●	●	○	
	●	●	●	●	○		●	○	
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