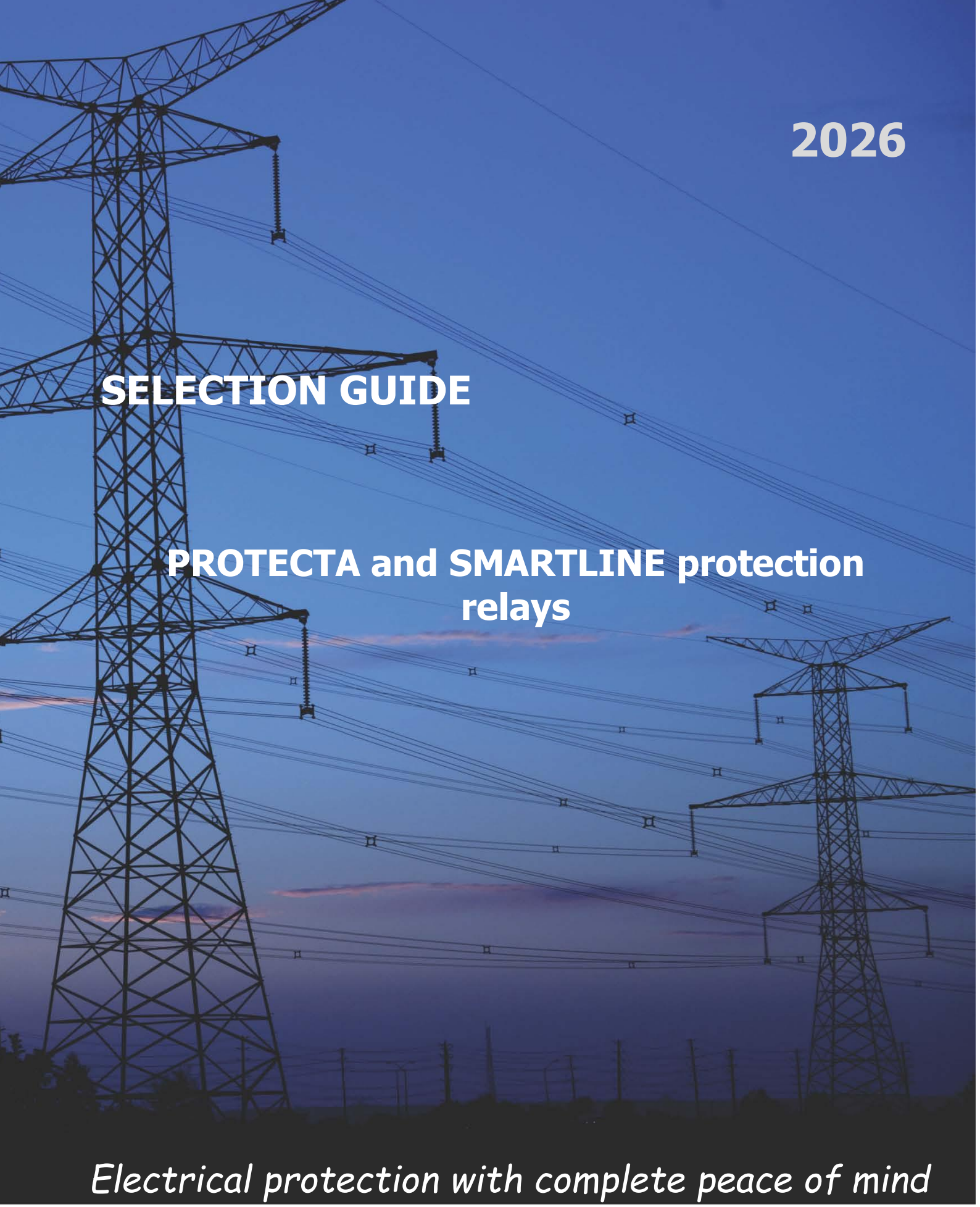


2026

SELECTION GUIDE

PROTECTA and SMARTLINE protection relays

Electrical protection with complete peace of mind

MICROENER

TABLE OF CONTENTS

OVERVIEW

MICROENER, in partnership with **PROTECTA** for over **15 years,** offers intelligent electronic devices (IEDs) for protection against electrical faults and control of medium and high voltage electrical networks. The product families offered by MICROENER are based on the long experience of these two partners in the field of electrical networks.
The hardware and software protection devices in the **Protecta** range are modular. The modules are assembled and configured according to requirements, and the software then determines the functions (Software Function Block – SFB). The modular design of the hardware and software guarantees fully customized solutions to meet the needs of operators throughout the device's life cycle.

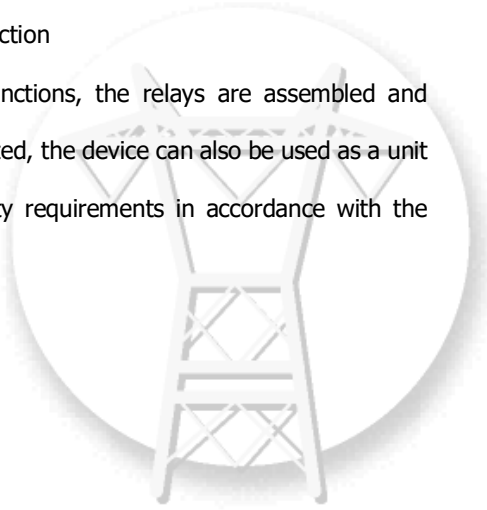
The **Smartline S24** range is a special selection of relays from the **Protecta** range designed for industrial installations. The equipment in these two ranges is unique in that it consists of **functional software blocks** (FSBs). These **FSBs** enable simple assembly in production to obtain the desired protection relay functions. The corresponding electronic cards are combined and assembled according to the BFLs required for protection. This unique assembly of **BFLs** and electronic cards, which constitute the relay hardware, ensures high reliability for the firmware embedded in the protections and electronics, as they are common to all devices and therefore widely distributed. Consequently, all test reports and certificates issued for the **Protecta** range apply to the **Smartline S24**.

General characteristics of the Protecta range relays

- **Upgradeable** hardware to suit different applications
- Flexible protection and control features to meet specific customer requirements and provide easy-to-implement upgrade solutions
- Thanks to customer-focused hardware and software design, the product offers easy-to-manage hardware and software engineering throughout the device's life cycle.
- Advanced HMI functionality via a color touch screen and integrated web server, extensive measurement, control, and monitoring functions
- The predefined factory configuration can be adapted to user specifications using the **EuroCAP** tool.

A reliable, secure, and tailor-made solution

- The integrated self-check function minimizes the risk of device malfunction
- Easy integration into retrofit applications
- Thanks to the **modular** architecture in terms of hardware and functions, the relays are assembled and configured according to user requirements.
- Due to the control, measurement, and monitoring functions implemented, the device can also be used as a unit control unit (station computer)
- Advanced integrated **cybersecurity** - Compliance with cybersecurity requirements in accordance with the BDEW white paper and NERC CIP guidelines and standards
- Can handle multiple communication protocols simultaneously

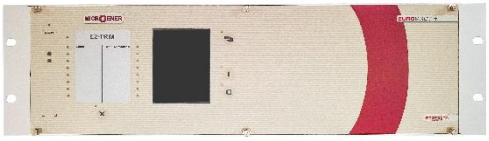


PRODUCT OVERVIEW

The **Protecta** and **Smartline** ranges consist of the following families:

DTVA - Protection and control of transmission lines

The relays in the DTVA family are configured to protect, control, and monitor transmission network (HTB) elements, where systems are typically directly grounded.



DTRV - Transformer protection and control

The relays in the DTRV family are designed for power transformer and generator protection and control applications, including generator-transformer units.

OGYD/DGYD - Busbar protection

OGYD and DGYD relays are designed to protect busbars.

DTIVA - Protection and control of industrial and distribution networks

The DTIVA family of relays are configured to protect, control, and supervise public distribution and industrial networks, whether they are antenna, looped, or meshed.

DAUT - Automation and control

The relays in the DAUT family are automation and control devices, such as a fast source transfer device, an automatic busbar transfer device, an arc suppression coil (Petersen) control device, a transformer inrush current limiter, an automatic generator synchronous coupler, etc.

DVEZ – Substation computer

DVEZ calculators are used for unit control applications in transmission and distribution networks.

SMARTLINE S24

The S24 series control and protection relays are designed to serve as primary or backup protection in industrial and utility power systems. S24 devices offer a wide range of protection and control functions in a space-saving package.

SMARTLINE S16

The S16 series relays are designed for high-voltage or low-voltage industrial installations and tertiary installations, for example to protect transformers. This series offers a less extensive range of features than the S24 series, but its **economical** positioning makes it a very good choice when simple functions are required.

PRODUCTS, APPLICATIONS, FEATURES

Range	Smartline	Protecta					
Family	**S24**	**VAT**	**DTRV**	**OGYD DGYD**	**DTIVA**	**DAUT**	**DEVZ**
Application							
Power plant Alternators, transformers, transformer blocks, synchronous couplers			■			■	
Transmission lines Distance and differential, single/three-phase reclosers		■					
Transformers Protection and control, voltage regulator, arc suppression, current limiter, synchrocheck	■		■			■	
Busbars Centralized/decentralized differential, automatic busbar transfer				■			
Distribution networks Underground/overhead feeders, capacitors, reclosers, load shedding control, regulation	■				■		
Industrial networks Arrivals, departures, motors, groups, loops, source transfer, protection, and control	■				■	■	
Railway substations Catenaries, transformers, protection and control					■		
Renewable energy Islanding protection, power return, generator	■		■		■		
Substation computer							■
Main features							
Auxiliary power supply	Wide dynamic range depending on the PS card selected - Nominal voltage from 24VDC to 220VDC - Nominal voltage from 110Vac to 230Vac						
Analog inputs	Conventional and/or resistive sensors						
Logic inputs	Wide dynamic range of logic input voltage - Nominal voltage from 24VDC to 230VDC						
Housing	- 144*144 mm (24TE). - DIN rail	- Half rack (42TE) or 19" rack (84TE) - Cabinet mounting, flush-mounted, semi-flush-mounted, front outlet surface-mounted, rear outlet surface-mounted, IP54 possible in flush-mounted with accessories					
Local HMI	- Default B&W display 128*64 pixels - 3.5" touchscreen option - 16 configurable signal LEDs + 1 status LED - RJ45 on front panel for configuration.						
Local control	Definition of controllable objects via the optional touch screen	Definition of controllable objects from the touch screen					
Communication	- IEC 61-850 - Serial (IEC 870-5-101/103, ModBus TRU, DNP3, ABB SPA) - Network IEC 870-5-104, DNP3, Modbus TCP						
		- Redundant Ethernet PRP/HSR					
Synchronization	- NTP server - Legal master protocol - Pulse - IRIG B000 or IRGB12X						
Monitoring	- Self-monitoring (watchdog) - CT and TT supervision - Recording of trip value - Supervision of the trip circuit (TCS)						
Fault analysis	- Large storage capacity (10,000 recorded events) - Oscillographic recordings of 32 analog and 64 digital signals (20 or 40 samples per cycle)						
Programming interface	- Local HMI - Eurocap software - Embedded web server						
Special module		- Remote HMI - Remote inputs/outputs - Temperature probes - Analog inputs (mA) - Rotor mass monitoring box					

COMMUNICATION

Flexible communication capabilities

- The relays have a front port for engineering purposes and several communication ports on the rear for remote access.
- The relays are IEC 61-850 native.
- Support for a full range of serial or Ethernet-based communication protocols and multiple parallel communication channels:
- Serial communication: DNP3.0; IEC60870-5-101/103; MODBUS, SPA
- Ethernet communication: IEC61850; IEC60870-5-104; DNP3.0 TCP; Modbus TCP
- Two independent Ethernet or serial protocols managed simultaneously on one channel
- Redundant PRP, HSR protocols

Interoperability and easy integration solutions

- Simple integration into modernization applications
- Native IEC 61850 IED with Edition 2 compatibility
- Interoperability compliant with IEC 61850 Edition 1 and Edition 2

Secure communication

- Advanced integrated cybersecurity - Compliance with cybersecurity requirements in accordance with the BDEW white paper
- Passwords are stored in encrypted form
- Equipment configuration management via a secure channel (SFTP)
- User-selectable access modes for the integrated web interface: enabled, disabled, read-only
- All types of user interactions are logged
- Security-related events can be sent to a remote logging server.
- Remote access can be authorized only for dedicated clients (whitelist)
- Access to IED management and SCADA can be controlled individually
- The local debug console is password protected

CONTROL, MONITORING, AND SUPERVISION

Self-monitoring

- Integrated self-monitoring to detect internal hardware or software errors in order to minimize the risk of device malfunction.
- Relevant self-diagnostic information is stored in various log files. This can be useful when analyzing problems and implementing appropriate corrective actions.

Secondary circuit supervision

- Improved monitoring and control of circuit breakers
- Robust trip contacts are integrated with a trip circuit supervision function. An alarm signal can be generated if an interruption is detected in the trip circuit.
- Monitoring of secondary circuits (current and voltage circuits) and detection of any abnormal conditions in these circuits.

Equipment condition monitoring

- Monitoring the status of primary equipment such as circuit breakers, transformers, or temperature can contribute effectively to the operation and maintenance process.
- Monitoring circuit breaker wear
- Monitoring the pressure of oil- or gas-insulated switching equipment
- Monitoring the oil temperature of transformers

Monitoring the quality of the electrical network

- The **Protecta** product range can monitor and detect current and voltage harmonics as well as short-term disturbances occurring on the electrical network or installation, such as
- Harmonic rates on each voltage and current channel
- Total harmonic distortion of current demand (TDD)
- Total harmonic distortion of voltage (THD)
- Dips, swells, and interruptions

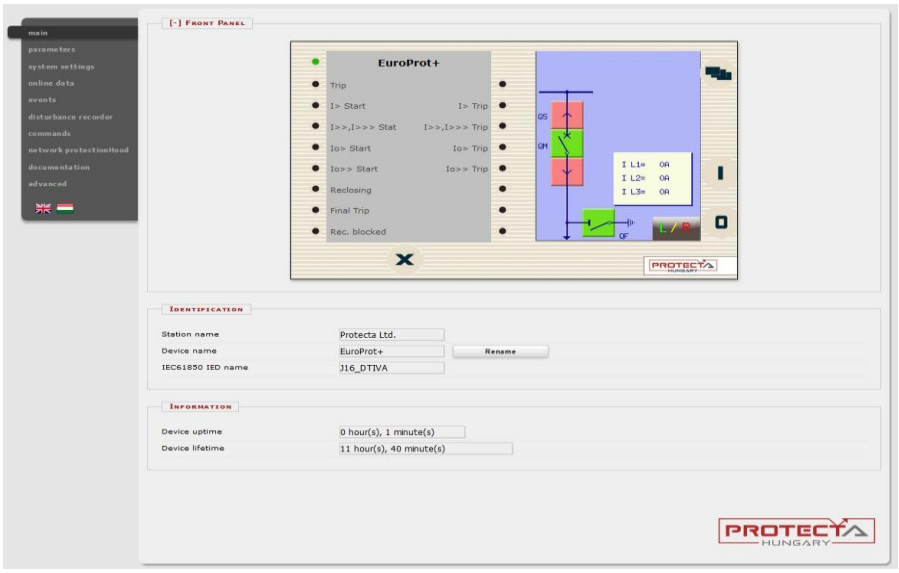
Status recorder and oscilloscope

- High-capacity event recording with 1 ms time stamping (more than 10,000 events can be stored) - data is stored in non-volatile memory
- Integrated disturbance recorder for up to 32 analog signal channels and 64 digital signal channels (sampling rate of 20 or 40 samples/cycle, selectable via software). Recordings are stored in the IED's non-volatile memory in the standard COMTRADE file format.
- Depending on the standard configuration selected, an integrated fault locator for calculating fault impedance and distance to fault is available.

DEVICE PROGRAMMING - CONFIGURATION, PARAMETERIZATION

User interface

Protecta devices communicate over standard Ethernet networks; settings can be configured using any standard browser (Chrome, Firefox, Edge, etc.).

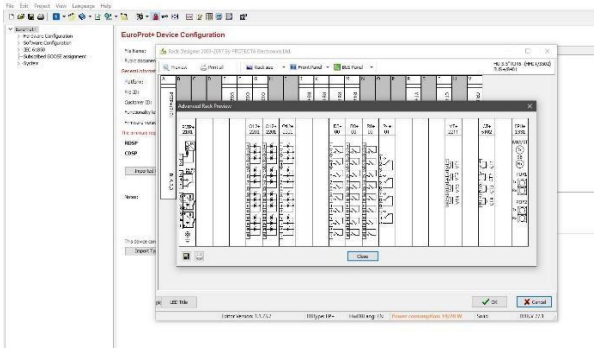


EuroCAP configuration tool

The EuroCAP configuration tool, available free of charge on our website, offers a user-friendly and flexible application for protection, control, and measurement functions to ensure that devices in the **Protecta** product line are fully customizable.

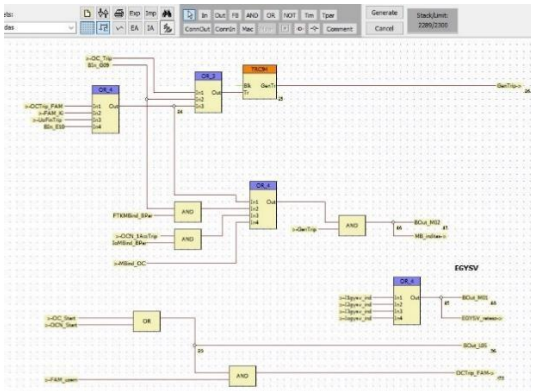
HW Configuration

- View the exciting hardware configuration of the equipment, including card information and slot position.
- Modify (add or change) certain HW modules
- Define digital and analog I/O signals



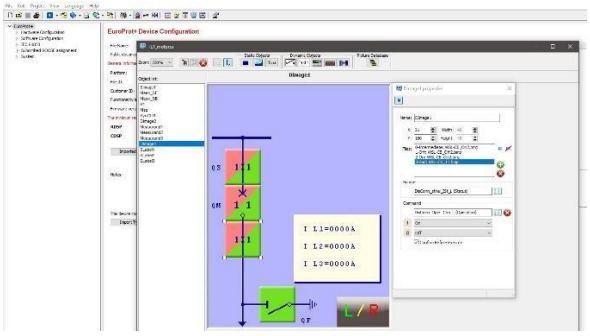
Logic editor

- Create/manage logic sheets
- Factory-preconfigured logic diagrams to speed up the commissioning process



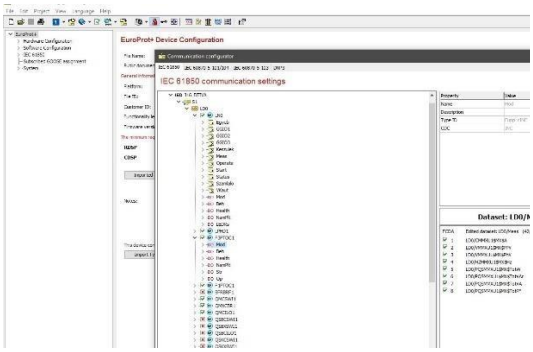
LCD configurator (available with color TFT screens)

- Create/edit user screens with single-line diagrams, measurement values, or status values.
- Icon library for efficient configuration. User-defined symbols can also be created.



Communication configurator

- Implementation of IEC 61850, 101-104, 103, DNP3 communication protocols
- Configure the properties of data sets, reports, and the goose control block for horizontal and vertical communication according to the IEC 61850 standard
- GOOSE configuration between IEDs



Offline parameter editor

- View, adjust, compare, and save equipment parameter settings.
- Import existing parameters into the offline parameter set editor from the IED
- Import/export parameters in xlsx format
- Generate and save parameters in RIO format for the relay tester

Feedback documentation

Automatic documentation of the configured IED, which may contain connection assignments, online measurements, all recorded event channels, all recorded disturbance channels, LED assignments, logic sheets, and relevant communication parameters, as well as protection, control, and monitoring parameters.

RELAY FUNCTIONALITY OVERVIEW

Functions	Code	DTVA		DTRV										OGYD	DGYD	DTI VA	
		/L	/Di	/T2	/T2V	T2R	/T3	/T3V	/T3R	/TR	/TZ	/TG	/G			/F	/D
Range		PROTECTA															
Minimum protection from Z (distance)	21	X	X														
Minimum Z protection (circular)	21										X						
Overexcitation protection	24				X	X		X	X		X	X	X				
Synchrocheck	25	X	X									X	X				
Minimum direct U protection	27D																
Maximum power directional protection	32	X	X									X	X				X
Directional protection with mini power	32	X	X									X	X				X
Minimum current protection	37																
Excitation loss protection	40											X	X				
Reverse current maximum protection	46	X	X	X	X	X	X	X	X	X	X	X	X			X	X
Maximum protection at inverse U	47	X	X		X	X		X	X								X
Engine start monitoring	48																
Thermal image protection	49	X	X	X	X	X	X	X	X			X	X			X	X
Instantaneous maximum phase protection	50	X	X	X	X	X	X	X	X			X	X			X	X
Circuit breaker failure protection	50BF	X	X	X	X	X	X	X	X			X	X	X	X	X	X
Maximum phase protection with delay	51	X	X	X	X	X	X	X	X		X	X	X			X	X
Instantaneous maximum ground fault protection	50N	X	X	X	X	X	X	X	X			X	X			X	X
Maximum ground fault protection with time delay	51N	X	X	X	X	X	X	X	X		X	X	X			X	X
Maximum zero-voltage protection	59N	X	X		X	X		X	X		X	X	X				X
Fuse (VTS)	60	X	X									X	X				
Unbalanced current protection	60	X	X	X	X	X	X	X	X	X	X	X	X			X	X
Monitoring the number of starts	66																
Maximum protection I directional phase	67	X	X														
Directional maximum I earth protection	67N	X	X		X	X		X	X		X						X
Anti-pumping protection	68	X	X														
Inrush current detection and blocking	68	X	X													X	X
Protection against loss of synchronization	78	X	X									X	X				
Recloser	79	X	X													X	X
Maximum frequency protection	81O	X	X		X	X		X	X			X	X				
Minimum frequency protection	81U	X	X		X	X		X	X			X	X				
Frequency gradient protection	81R	X	X		X	X		X	X			X	X				
Remote protection	85	X	X														
Differential bars	87B													X	X		
Transformer differential protection	87T			2w	2w	2w	3w	3w	3w			X					
Restricted ground protection	87N/REF			X	X	X	X	X	X		X						
Line/cable differential protection	87L		X														
Generator differential protection (longitudinal)	87G												X				
Voltage regulator	90					X			X	X							
Fault closure		X	X														
Unit for decentralized Jdb protection		Op.															Op.
Current (I1, I2, I3, Io)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency		X	X		X	X		X	X	X	X	X	X	X	X		X
Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)		X	X							X	X	X	X				X
Circuit breaker wear		X	X													X	X
Supervision of trigger contacts		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Calculator		X	X	X	X	X	X	X	X	X	X	X	X			X	X
Voltage regulator						X			X	X							
Enclosure		Op.	Op.	Op.	Op.	Op.	Op.	84	84	Op.	Op.	Op.	Op.	84	84	Op.	Op.
Rack mounting		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Current inputs (4th unit ground)		4	4	8	8	8	12	12	12	8	4	8	8	12	12	4	4
Inputs Voltage		4	4	-	4	8	-	4	8	8	4	8	8	4	4	-	4
Logic inputs		12	12	12	12	12	12	12	12	12	12	12	12	Op.	60	12	12
Logic outputs		8	8	8	8	8	8	8	8	8	8	8	8	Op.	16	8	8
Fast-acting release relay		4	4	4	4	4	8	8	8	-	4	4	4	Op.	12	4	4
Temperature probes (RTDs) *	38/49T	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
Oscillographic recordings		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Event logging		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Front panel Ethernet		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
IEC 61850		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-101		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-103		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-104		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
SPA bus		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
Modbus RTU and Modbus TCP/IP		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
DNP 3.0 and DNP 3.0 - TCP/IP		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.

MICROENER

CHOICE GUIDE

Functions	Code	DTIVA									TRIM/POW	HSBT	DRFP	DRL	DVEZ	METRA	ASZKG
		/Fr	/L	/Di	/LD	/M	/MD	/U	/P	/C							
Product range		PROTECTA															
Minimum Z protection (distance)	21		X		X												
Overhead line protection	21												X				
Overvoltage protection	24																
Synchrocheck	25	X	X		X							X					X
Fast source switching	25											X					
Undervoltage protection	27	X	X	X	X	X	X	X	X	Op.			X				X
Minimum direct U protection	27D					X	X										
Maximum power directional protection	32	X	X		X				X								
Directional protection with mini power	32	X	X		X				X								
Minimum current protection	37					X	X										
Maximum reverse current protection	46	X	X	X	X	X	X										
Maximum protection at inverse U	47	X	X		X	X	X										
Engine start monitoring	48					X	X						X				
Thermal image protection	49	X	X	X	X	X	X										
Instantaneous maximum phase protection	50	X	X	X	X	X	X										
Circuit breaker failure protection	50BF	X	X	X	X	X	X		X								
Instantaneous maximum earth fault protection	50N	X	X	X	X	X	X										
Maximum phase protection with delay	51	X	X	X	X	X	X		X	X			X				
Maximum ground fault protection with time delay	51N	X	X	X	X	X	X		X	X							
Protection at minimum I to minimum U	51V																
Surge protection	59	X	X	X	X	X	X	X	X	Op.			X				X
Maximum zero-voltage protection	59N	X	X	X	X	X	X	X	X	Op.				X			
Fuse (VTS)	60		X		X												
Unbalanced current protection	60	X	X	X	X	X	X		X	X							
Monitoring the number of starts	66					X	X										
Directional phase maximum protection	67	X	X		X												
Directional maximum I earth protection	67N	X	X		X	X	X										
Selectivity through blocking or information exchange	68	X	X	X	X	X	X	X	X	X							
Inrush current detection and blocking		Op.	Op.	Op.	Op.	Op.	Op.										
Vector jump protection	78								X								
Recloser	79	X	X	X	X								X				
Maximum frequency protection	81O	X	X		X		X	X	X								X
Minimum frequency protection	81U	X	X		X		X	X	X								X
Frequency gradient protection	81R	X	X		X		X	X	X								
Remote protection	85																
Generator differential protection (longitudinal)	87G						X										
Line/cable differential protection	87L			X	X												
Compensation reel management system														X			
Transformer inrush current reduction											X						
Unit for decentralized Jdb protection																	
Automatic busbar transfer																X	
Current (I1, I2, I3, Io)		X	X	X	X	X	X		X	X	Op.	Op.					
Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency		X	X	X	X	X	X	X	X	Op.	X	X					
Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)		X	X	X	X	X	X		X								
Circuit breaker wear		X	X	X	X	X	X				X	X				X	
Supervision of trigger contacts		X	X	X	X	X	X	X		Op.		Op.					
Calculator		X	X	X	X	X	X		X	X					X		
Voltage regulator																	X
Box		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
Rack mounting		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Current inputs (4th unit ground)		4	4	4	4	4	8	-	4	4	3		X	X	Op.		
Inputs Voltage		4	4	4	4	4	4	4	4	Op.	4	3	X	X	Op.		9
Logic inputs		12	12	12	12	12	12	12	12	12	12	12	12	12	Op.	Op.	12
Logic outputs		8	8	8	8	8	8	8	8	8	8	8	8	8	Op.	Op.	8
Fast-acting release relay		4	4	4	4	4	4	4	Op.	Op.	Op.	Op.	4	4			
Temperature probes (RTDs) *	38/49T	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.			Op.	Op.	Op.		
Oscillographic recordings		X	X	X	X	X	X	X	X	X	X	X	X	X	Op.		X
Event logging		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Front panel Ethernet		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IEC 61850		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-101		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-103		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-104		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
SPA bus		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
Modbus RTU and Modbus TCP/IP		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
DNP 3.0 and DNP 3.0 - TCP/IP		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op	Op.	Op	Op.	Op.	Op.	Op.

Functions	Code	S24									S16				
		/F	/Fr	/G	/L	/LD	/T	/DG	/U	/HZ	/F	/M	/U	/DT	/MDT
Range		SMARTLINE													
Minimum Z protection (distance)	21				X										
Overvoltage protection	24		X	X											
Synchrocheck	25				X				X						
Undervoltage protection	27		X	X	X				X				X		
Minimum direct U protection	27D		X	X	X										
Maximum power directional protection	32		X	X											
Directional protection at minimum power	32														
Minimum current protection	37	X	X	X						X		X			X
Excitation loss protection	40			X											
Reverse current maximum protection	46	X	X	X	X	X	X	X		X		X			X
Maximum protection at inverse U	47		X	X	X										
Motor start monitoring	48	X										X			X
Thermal image protection	49	X	X	X	X	X	X	X		X		X			X
Instantaneous maximum phase protection	50	X	X	X	X	X	X	X		X	X	X		X	X
Circuit breaker failure protection	50BF	X	X	X	X	X	X	X		X					
Instantaneous maximum earth fault protection	50N	X	X	X	X	X	X	X		X	X	X		X	X
Maximum phase protection with delay	51	X	X	X	X	X	X	X		X	X	X		X	X
Maximum ground fault protection with time delay	51N/64	X	X	X	X	X	X	X		X	X	X		X	X
Protection at minimum I to minimum U	51V		X	X											
Surge protection	59		X	X	X				X				X		
Maximum zero-voltage protection	59N		X	X	X				X				X	X	X
Fuse (VTS)	60		X	X					X						
Unbalanced current protection	60	X	X	X	X	X	X	X		X					
Monitoring the number of starts	66	X								X		X			X
Maximum protection I directional phase	67		X	X	X										
Directional maximum I earth protection	67N		X	X	X									X	X
Blocking or information exchange function	68	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Anti-pumping protection	68														
Inrush current detection and blocking	68	X	X	X	X	X				X					
Vector jump protection	78		X	X									X		
Protection against loss of synchronization	78														
Recloser	79	X	X	X	X	X				X					
Maximum frequency protection	81O		X	X	X				X				X		
Minimum frequency protection	81U		X	X	X				X				X		
Frequency gradient protection	81R		X	X	X				X				X		
Differential protection Synchronous motor	87G/M							X							
Line/cable differential protection	87L					X									
Restricted ground protection	87N		Op.	Op.			Op.	Op.						Op.	
Transformer differential protection	87T						X								
Transient ground fault															
Current (I1, I2, I3, Io)		X	X	X	X	X	X	X		X	X	X		X	X
Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency			X	X	X				X				X		
Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)			X	X	X										
Circuit breaker wear															
Monitoring of trip contacts		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.					
Calculator															
Voltage regulator															
DIN rail mounting											X	X	X	X	X
Flush-mounted (and semi-flush-mounted) installation		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Current inputs		4	4	4	4	4	4	4	4	4	4	4		4	
Input Voltage			4	4	4								4		4
Logic inputs		6	6	6	6	6	6	6	6	6	4	4	4	4	4
Logic outputs		5	5	5	5	5	5	5	5	5	4	4	4	4	4
Fast-acting relay		2	2	2	2	2	2	2	2	2	2	2	2	2	2
Temperature probes (RTDs) *	38/49T	Op.					Op.	Op.							
Oscillographic recordings		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Event logging		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Front panel Ethernet		X	X	X	X	X	X	X	X	X					
IEC 61850		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.					
IEC 60870-5-101		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-103		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
IEC 60870-5-104		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.					
USB2 on front panel											X	X	X		X
Modbus RTU or Modbus TCP/IP		Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.					
DNP 3.0 and DNP 3.0 - TCP/IP															

ANSI CODES

Several international standards define the functionalities of protection relays. The EN60617-7 standard specifies the symbols relating to these functions. The American ANSI C37-2 standard uses numbers to indicate the functionality of the protection relay in question. The table below provides a complete list of the functions defined in this standard.

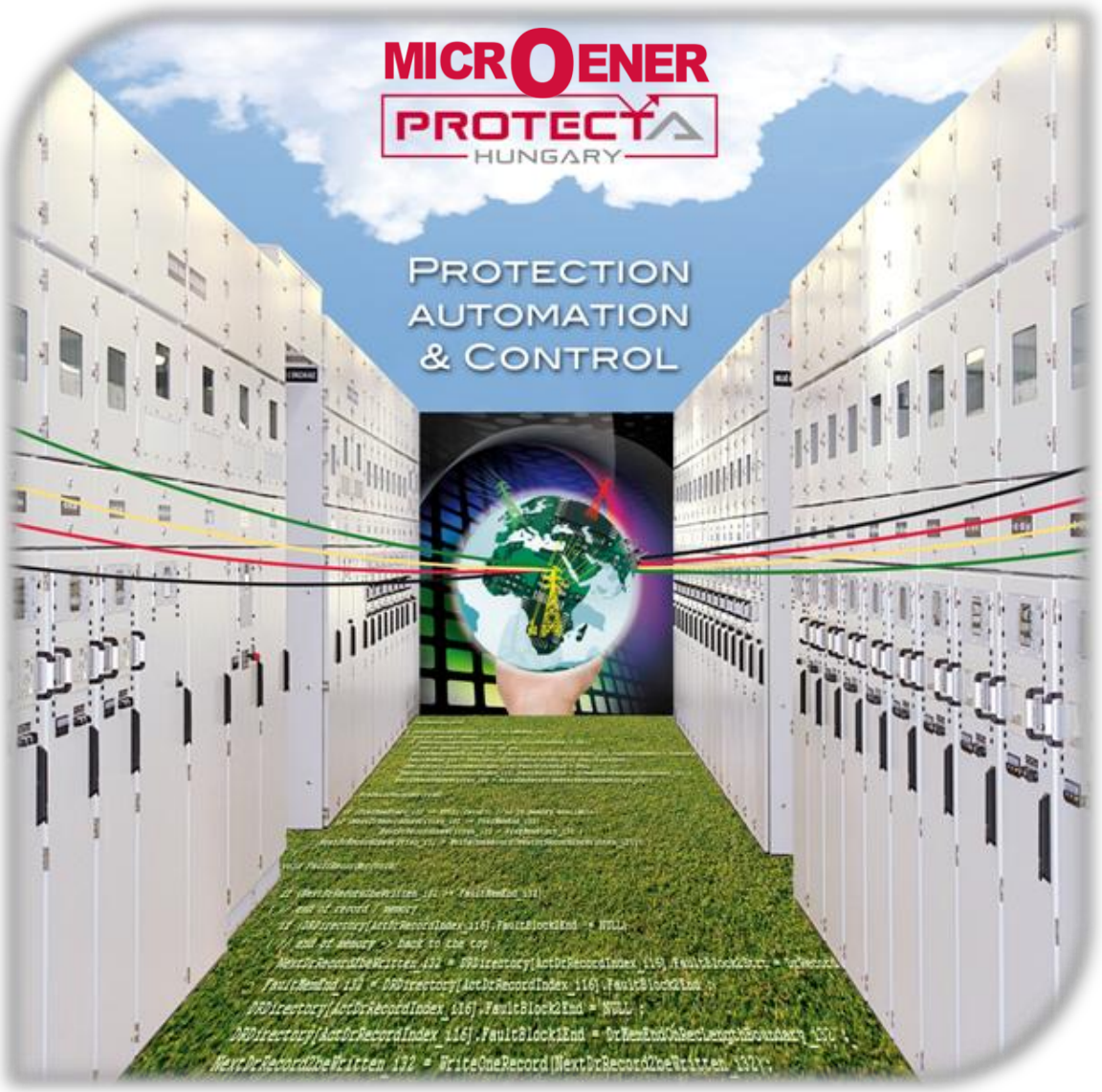
Code	Definition	Function
1	Master element	This is the start-up element, such as a cut-off or control device, an auxiliary relay, etc. It acts either directly or through an authorization element such as a protection device or a time delay relay to switch equipment on or off.
2	Delayed relay Go or Return	Element that operates to issue the desired command before or after a delay as part of a protection system switching sequence (does not apply to functions 63 and 79).
3	Verification or interlock relay	A device that operates in response to a position, a series of other elements, or a predetermined number of conditions to allow an operating sequence to be established, stopped, or to verify the position of these elements or conditions.
4	Master contactor	A device that is usually controlled by another device and requires authorization and protective elements. It is used to establish or break a control circuit to put equipment into operation under desired conditions or to remove it from operation in the event of abnormal or other conditions.
5	Stop element	A device that stops or blocks the operation of equipment.
6	Start circuit breaker	Device whose main function is to connect a machine to its power source or starting voltage
7	Circuit breaker anode	Device used as an anode in power rectifier circuits which, when the rectifier circuits are interrupted, must withstand the electric arc.
8	Disconnecting device	Device such as a switch, circuit breaker, or fuse block used to connect or disconnect the power source to (or from) distribution busbars or equipment. **Note***: The power source is considered to include auxiliary sources that supply equipment such as small motors, etc.*
9	Reversing element	Device used for any type of reversal on a machine or for performing any other reversing function.
10	Switching sequence unit	Device used to change the sequence in which units can be switched on or off.
11	Reserved for future applications.	
12	Overspeed detection	Device that is usually directly connected to the switch that indicates overspeed of the machine
13	Speed synchronization	Device such as a centrifugal speed contact, frequency slip relay, voltage relay, undercurrent relay, or any type of element operating approximately in synchronism with a machine.
14	Undervoltage detection	Device that operates when the speed of a machine falls below a predetermined value.
15	Speed or frequency monitoring	Set of devices for locking the speed or frequency of a machine or system when it is equal or approximately equal to that of another machine or system
16	Reserved for future applications	
17	Discharge or short-circuiting device	Switch used to open or close a short-circuiting device of any element of equipment (except a resistor) such as a machine, capacitor, or rectifier.
18	Acceleration or deceleration element	Device used to close or cause the closure of circuits that are used to increase or decrease the speed of a machine.
19	Start or transition contactor	Device that functions to initiate or cause the automatic transfer of a machine from its start-up phase to its normal operating connection.
20	Electric valve	Coil or valve motor that operates in vacuum, gas, oil, water, or similar media. **Note**: *The function of the valve may be indicated by the insertion of a simple description such as: "pressure reduction braking" or "electrically operated brake valve."*

Code	Definition	Function
21	Distance relay	Device that operates when the measurement of admittance, impedance, or reactance increases or decreases outside predefined limits
22	Balancing circuit breaker	Circuit breaker used to control, establish, and interrupt connections that balance a machine or system in a multi-unit installation.
23	Temperature control	Device that controls increases or decreases in the temperature of machines or other devices. **Note**: *An example is the switching of a thermostat when it is placed in the location reserved for the heating radiator of the equipment... when the temperature falls below a desired value, as opposed to a device that is used to provide automatic recording of the temperature between limit values and which would be designated by code 90T.*
24	Reserved for future applications	
25	Synchronizer or synchronism checker	Device that operates when two AC circuits are within the desired limits of frequency, phase, and amplitude to allow or cause these two circuits to be connected in parallel.
26	Thermal device	Device that operates when the temperature of a shunt, machine winding damper, load, liquid, or any other system exceeds predetermined limits.
27	Undervoltage relay	Device that operates at a given undervoltage value.
28	Reserved for future applications.	
29	Isolation contactor	Device used exclusively to disconnect one circuit from another for operational, maintenance, or testing purposes.
30	Signaling relay	A non-automatically resetting signaling device that indicates a number of distinct visual indications when protective relays have operated and that can also perform interlocking operations.
31	Separate excitation	Device that connects the excitation circuit of a synchronous converter to a separate excitation source during the start-up phase, or that engages or starts the ignition circuit of power rectifiers.
32	Directional power relay	A device that operates at a predetermined power value in a given direction or at the return of power resulting from an arc return in the anode or cathode of a power rectifier circuit.
33	Position contact	Establishes or breaks a contact when the main device or a piece of equipment that does not have a code reaches a given position.
34	Motor switching sequence	A set of several contacts that determines the operating sequences of a main device during its start-up or shutdown phases or during other operating phases.
35	Short-circuit brushes or rings	Device used to increase, decrease, or shift the brushes of a rotating machine for short-circuiting its rings or for engaging or disengaging the contacts of a rectifier
36	Polarity element	Device that operates or enables the operation of another device for a predetermined polarity only.
37	Under-current relay or under-load relay	Device that operates when the current or power flowing through the installation falls below a predetermined value.
38	Bearing protection element.	Device that operates when excessive bearing temperatures are reached or other mechanical problems are detected as abnormal usage that may possibly be the result of excessive bearing temperatures
39	Reserved for future applications	
40	Field relay	Device that operates for an abnormally low value or a break in the armature current or on an excessive value of its reactive component indicating an abnormally low value of the excitation
41	Excitation circuit breaker	Device that operates to apply or remove the excitation field of a machine.
42	Start circuit breaker	Device whose main function is to connect a machine to its power source after it has been brought up to the desired speed by the start connection.

Code	Definition	Function
43	Manual transfer or selection device	Device that transfers control circuits in order to modify the operating plan of switching equipment or certain elements thereof
44	Start relay	Device that operates to start the next available unit in a multi-unit installation following the failure or unavailability of the normally scheduled unit.
45	Reserved for future applications	
46	Phase reversal or phase current imbalance	Device that operates when polyphase currents are reversed or when polyphase currents are unbalanced or contain a reverse component above a given level.
47	Voltage phase sequence	Device that operates for a predetermined value of polyphase voltage in a given phase sequence.
48	Incomplete start	Device that returns equipment to an initial or stopped position and locks it if the normal start sequence or stop sequence has not been completed correctly within a given time.
49	Thermal relay	A device that operates when the temperature of an alternating current machine, a load with windings, a direct current machine, or a rectifier exceeds a predetermined value.
50	Instantaneous overcurrent or rate of current increase	A device that operates instantly when the current exceeds a certain value, or when the rate of increase in current exceeds a certain value, indicating a fault in the protected equipment, apparatus, or circuit.
51	Time-delayed alternating overcurrent	A device that is either constant time or time dependent that operates when the alternating current exceeds a predetermined value.
52	Alternating current circuit breaker	A device used to open or close an AC power circuit under normal operating conditions or to interrupt a circuit under emergency or fault conditions.
53	Excitation or DC generator relay	A device that forces the excitation of a DC machine to increase during the start-up phase or that operates when the machine voltage has reached a given value.
54	Fast DC circuit breaker	A circuit breaker that trips to reduce the current in the main circuit within 0.01 seconds or less after the overcurrent relay has operated or there has been a rapid increase in overcurrent.
55	Power factor	Device that operates when the power factor in an AC circuit is above or below a predetermined value.
56	Field application	Device that automatically controls the application of an excitation field to an AC motor at a specific point
57	Short-circuiting or grounding	Device that operates to short-circuit or ground a circuit in response to an automatic or manual request
58	Faulty rectifier	Device that operates if one or more diodes in a rectifier fail
59	Overvoltage relay	Device that operates at a given overvoltage value.
60	Voltage difference relay	Device that operates for a given voltage difference between two circuits
61	Current difference relay	Device that operates for a given current difference at the input or output of two circuits.
62	Delayed shutdown or opening relay	A time-delay device that is used in conjunction with a device that initiates a permanent shutdown or opening in an automatic sequence.
63	Pressure, level, gas or liquid circulation	Device that operates at a given value of liquid, gas pressure, level, or flow, or at a given rate of these parameters
64	Ground fault relay	Device that operates for a failure of the insulation to ground of a machine, transformer, or other equipment, or for a grounding of a DC machine **Note**: This function is defined only for a relay that detects the flow of current from the frame of a machine, a metal enclosure, or a piece of equipment to ground. It can also be used to detect insulation faults on winding circuits that are normally isolated from ground. It is not applicable for a device whose secondary is connected to earth via a deliberate connection through a current transformer or when current transformers are measured from line currents.

Code	Definition	Function
65	Regulator	Device that controls the opening of valves or gates in the engine or drive turbine
66	Positioning or rotation	Device that operates for a specified number of operations for a given piece of equipment or for a specified number of successive operations within a given time. It also operates to periodically engage a circuit, or is used to allow intermittent acceleration or rotation of a machine at slow speeds for mechanical positioning.
67	Directional overcurrent relay	A device that operates for a desired value or current flow (overcurrent) in a predetermined direction.
68	Blocking relay	Device that initializes a pilot signal for: Blocking tripping on external faults on a transmission line or on any other equipment under predetermined conditions. Coordinate with other devices to block tripping or reclosing on loss of synchronism or power flicker conditions
69	Authorization control	Device generally with two positions. In one position, it allows the circuit breaker to close or equipment to be started up. In the other position, it prepares the circuit breaker or equipment to operate.
70	Electrically controlled rheostat	A rheostat used to adjust the resistance value of a circuit in response to various electrical commands or controls.
71	Reserved for future applications.	
72	Circuit breaker for direct current circuits	Device used to close or open a direct current power circuit under normal operating conditions or to interrupt this circuit in the event of a fault or emergency conditions.
73	Load switch	A device used to bypass or insert a load assembly into a power circuit, or which
74	Alarm relay	A device different from a signaling relay (No. 30), used to operate in conjunction with a visual or audible alarm.
75	Position change mechanism	Mechanism used to move a plug-in circuit breaker to or from its connected, disconnected, or test position.
76	Direct current overcurrent relay	Device that operates when the current in a DC circuit exceeds a given value.
77	Pulse transmitter	Device used to generate and transmit pulses via telemetry circuits or pilot wires to a remote device.
78	Phase angle measurement or loss of synchronization relay	Device that operates to measure a predetermined phase angle between two voltages or between two currents or between a current and a voltage.
79	Alternating recloser	Device that controls the automatic reclosing and locking of an AC circuit breaker.
80	Reserved for future applications	
81	Frequency relay	Device that operates at a predetermined frequency value, either an increase or decrease from the normal value or from a rate or variation in frequency.
82	Direct current recloser	A device that controls the closing and reclosing of a DC circuit breaker in response to load conditions.
83	Selective automatic control or transfer	Device that operates to automatically select between certain sources or conditions in equipment or performs an automatic source transfer operation.
84	Operating mechanism	Complete electric mechanism or servo mechanism incorporating the control motor, coils, position contacts, for any part that does not have a code for an inductive load regulator or voltage regulator
85	Pilot wires, receiver, or carrier	Device that is activated or held by a signal using a power line connection or DC pilot wires from a "directional" fault relay.
86	Locking relay	Device that operates electrically or is reset electrically and functions to shut down or disable equipment in the event of abnormal conditions.

Code	Definition	Function
87	Differential protection	Device that operates based on a percentage, phase angle, or other quantity for a difference between two currents or certain other electrical quantities
88	Auxiliary motor	Device used to operate other equipment such as pumps, fans, exciters, rotating magnetic amplifiers
89	Line switch	Device used as a switching element to disconnect or isolate in an AC or DC power circuit, which operates electrically or is equipped with electrical accessories such as auxiliary contacts, locking coil, etc.
90	Regulation element	Device that operates to regulate one or more quantities such as voltage, current, power, speed, frequency, temperature, or load to a certain value or within certain limits for a machine, line, or other device.
91	Directional Voltage Relay	A device that operates when the voltage across an open circuit breaker or contactor exceeds a given value in a given direction.
92	Directional power and voltage relay	A device that allows or causes two circuits to be connected when the voltage difference between them exceeds a given value in a predetermined direction, and causes these two circuits to be disconnected from each other when the power flowing between them exceeds a given value in the opposite direction.
93	Field variation contactor	Device that functions to increase or decrease the value of the excitation field of a synchronous machine by one unit.
94	Trip relay	Device that operates to engage a switching device or equipment, or to enable tripping by another device, or to prepare for immediate reclosing of the switching device in the event that it should open automatically even though its closing circuit is kept active.
95 to 99		Used only for specific applications on individual or special installations where none of the existing codes are suitable.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49 rue de l'Université - 93160 Noisy le Grand – Tél : +33 1 48 15 09 01 – Fax : +33 1 43 05 08 24
info@microener.com – www.microener.com