PDZI9000

AC Catenary Protection
25 kV & 2x25 kV

Our PDZI9000 protection relay protects the fixed electric traction installations responsible for supplying the catenaries with alternating current 25 kV or 2x25 kV, 50 or 60 Hz.

Thanks to a hybrid acquisition of currents and voltages (through sensors or IEC 61850-9-2 SV), it facilitates the operation of your railway electrical network.

Based on more than 40 years of experience in this field, our PDZI9000 relay is part of our 9000 Series designed for monitoring and controlling railway systems.

- High resolution colour touch screen
- Embedded web server
- IEC 61850 ed2 or Modbus servers

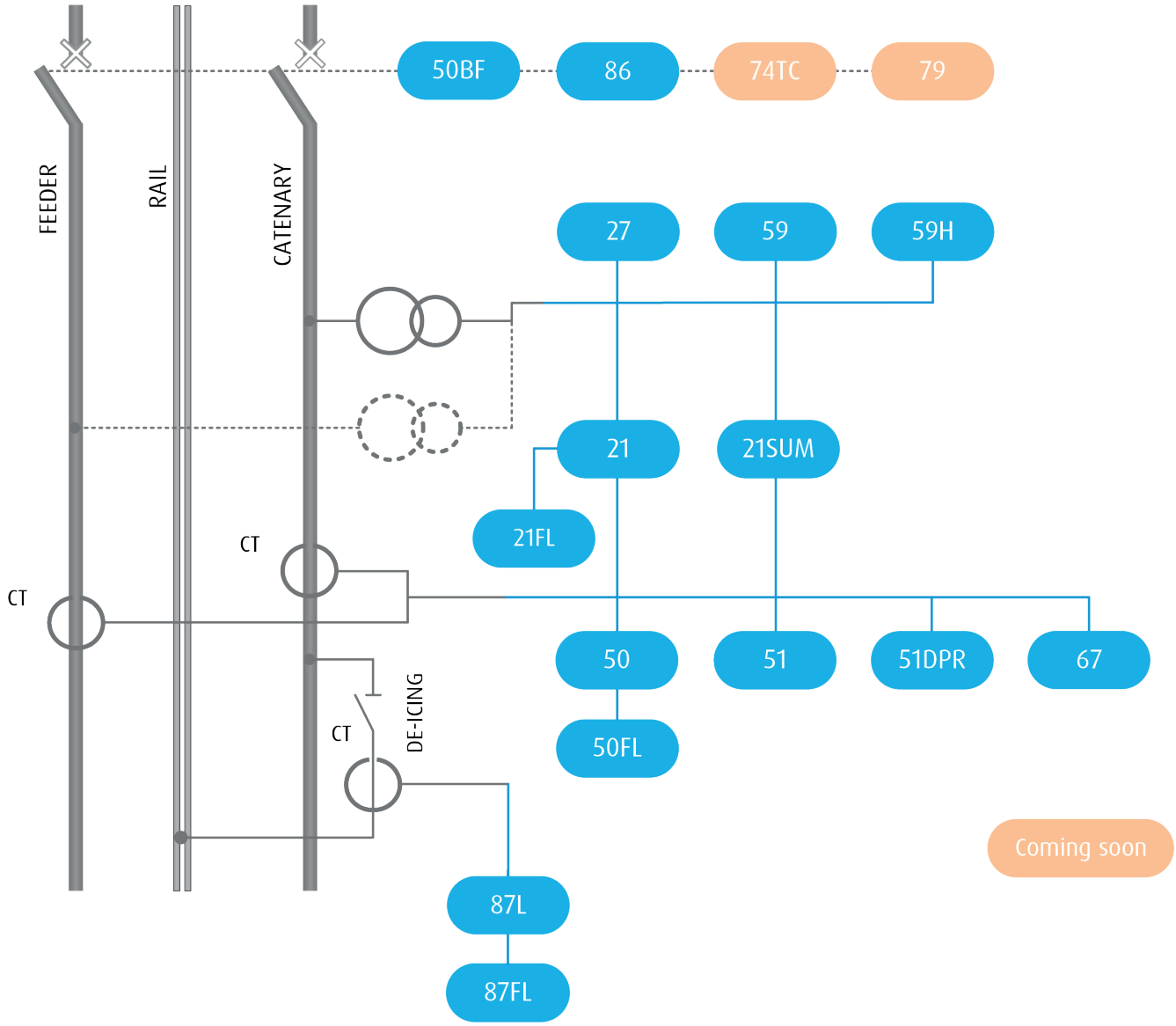
- 2x16 A circuit breaker outputs
- 28 configurable digital outputs
- 18 configurable digital inputs
- 16 configurable LEDs

- 48 VDC to 125 VDC ± 10% power supply
- 19" - 3U - 355mm rack

- Performance
  - Instantaneous tripping time < 30 ms
  - Sampling rate: 6.4 kHz
  - Operating temperature : -5 °C to 55 °C

- Main standards
  - Design according to IEC 60255
  - EMC according to IEC 61000-4-*
  - Communication according to IEC 61850
  - CE marking according to IEC 60255-27

FUNCTIONAL SCHEME



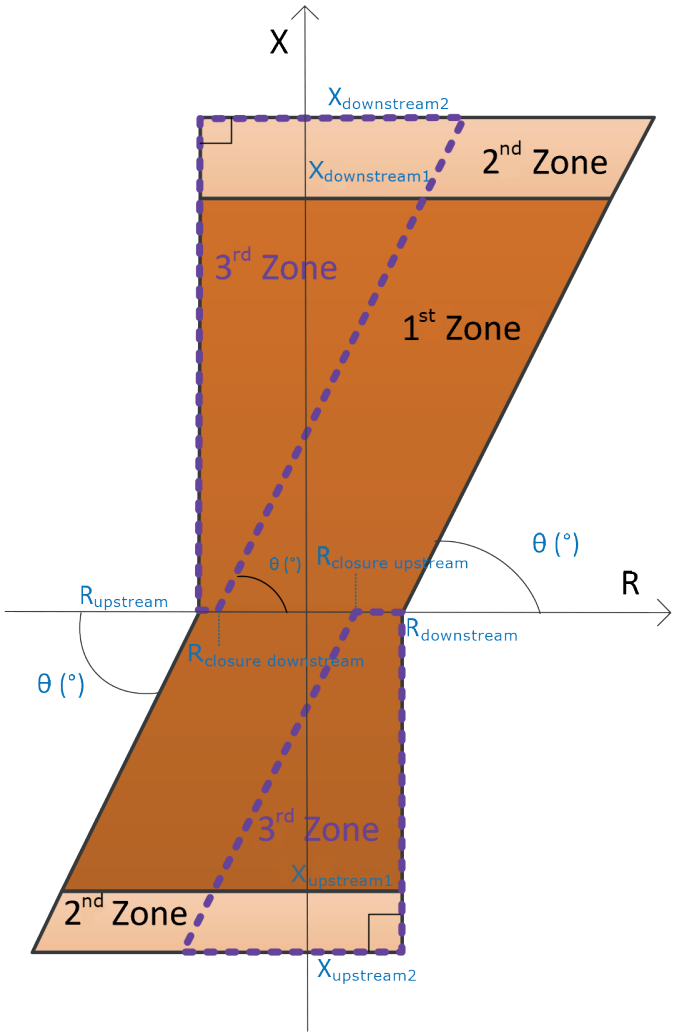
PROTECTION FUNCTIONS

- **[21]** Underimpedance function
- **[50] [51]** Overcurrent function
- **[51DPR]** Power Swing Detection function
- **[21SUM]** Underimpedance summing function
- **[50BF]** Breaker failure function
- **[87L]** De-icing function
- **[67]** Directional function
- **[27]** Undervoltage function
- **[59]** Overvoltage function
- **[59H]** Harmonic Overvoltage function

OPERATING FUNCTIONS

- **[21FL] [50FL] [87FL]** Fault locator function
- **[86]** Circuit breaker monitoring
- *[74TC] Trip circuit supervision function*
- *[79] Autoreclose function*
- Disturbance recording
- Logic selectivity

UNDERIMPEDANCE FUNCTION [21]



Settings	CT 5 A	CT 1 A
1st or 2nd zone enabling	Yes / No	
3rd zone enabling	1x25 kV: Always disabled	
	2x25 kV: Yes / No	
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step	
Resetting percentage	101 to 120%	
2x25kV autotransformer closure detection	3rd zone polygon / 2nd harmonic rank	
$X_{downstream1}$, $X_{upstream1}$, $X_{downstream2}$, $X_{upstream2}$ thresholds	0.2 to 150.0 Ω | 0.1 Ω step	1.0 to 750.0 Ω | 0.5 Ω step
$R_{downstream}$, $R_{upstream}$, $R_{closure\ downstream}$, $R_{closure\ upstream}$ thresholds	1.6 to 50.0 Ω | 0.1 Ω step	8.0 to 250.0 Ω | 0.5 Ω step
Line angle θ°	50° à 85° | 1° step	
1st area time delay T1	40 ms to 500 ms | 10 ms step	
2nd area time delay T2	40 ms to 500 ms | 10 ms step	
3rd area TH2 time delay T3	40 ms to 2 seconds | 10 ms step	
Harmonic threshold	10 to 70% | 5% step	
Closure time delay	0 to 5 seconds | 0.1 s step	

UNDER IMPEDANCE SUMMING PROTECTION FUNCTION [21SUM]		
Settings	**CT 5 A**	**CT 1 A**
1st or 2nd zone enabling	Yes / No	
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step	
Resetting percentage	101 to 120%	
$X_{downstream1}$, $X_{upstream1}$, $X_{downstream2}$, $X_{upstream2}$ thresholds	0.2 to 150.0 Ω | 0.1 Ω step	1.0 to 750.0 Ω | 0.5 Ω step
$R_{downstream}$, $R_{upstream}$, $R_{closure\ downstream}$, $R_{closure\ upstream}$ thresholds	1.6 to 50.0 Ω | 0.1 Ω step	8.0 to 250.0 Ω | 0.5 Ω step
Line angle θ°	50° to 85° | 1° step	
1st zone time delay T1	40 ms to 500 ms | 10 ms step	
2nd zone time delay T2	40 ms to 500 ms | 10 ms step	
Inhibition delay	40 ms to 2 seconds | 10 ms step	

OVERVOLTAGE FUNCTION [59]	
Settings	**Value**
Ucat U1 & U2 threshold enabling	Yes / No
Ufeed U1 & U2 threshold enabling	Yes / No
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step
Resetting percentage	90 to 99%
Overvoltage threshold	110% to 160% | 1% step
Time delay threshold 1	1 s to 600 s | 1 s step
Time delay threshold 2	0.04 s to 10 s | 10 ms step
Monitoring mode	Ucat OR Ufeed / Ucat AND Ufeed

UNDERVOLTAGE FUNCTION [27]	
Settings	**Value**
Ucat U1 & U2 enabling	Yes / No
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step
Resetting percentage	101 to 110%
Undervoltage threshold	50% to 90% | 1% step
Undervoltage Ucat & Ufeed time delay	0.04 s to 10 s | 10 ms step
CB tripping by undervoltage	Yes / No
Monitoring mode	Ucat OR Ufeed / Ucat AND Ufeed

OVERCURRENT FUNCTION [50] [51]		
Settings	**CT 5 A**	**CT 1 A**
Threshold 1, 2 & 3 enabling	Yes / No	
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step	
Resetting percentage	90 to 99%	
Threshold 1, 2 & 3	2.0 A to 50 A | 0.1 A step	0.40 A to 10.00 A | 0.02 A step
Switch threshold 1, 2 & 3	2.0 A to 50 A | 0.1 A step	0.40 A to 10.00 A | 0.02 A step
Time delay threshold 1 & 2 type	Constant, Inverse configurable *According to IEC 60255-3*: Standard inverse | Very inverse | Extremely inverse | Long time inverse *According to ANSI/IEEE C37.122-1996*: Moderate inverse | Very inverse 2 | Extremely inverse 2 *US* standard: Inverse | Short time inverse	
Constant Time delay threshold 1 & 2	40 ms to 3.00 s | 10 ms step	
Dependent coefficient threshold 1 & 2	0.001 to 2.000 | 0.001 step	
Dependent coefficient β threshold 1 & 2	0.00001 to 200.00000 | 0.00001 step	
Dependent coefficient ∝ threshold 1 & 2	0.01 to 10.00 | 0.01 step	
Dependent coefficient L threshold 1 & 2	0 to 1.0000 | 0.0001 step	
Constant T3	0 ms to 0.30 s | 10 ms step	

Delay function on 2nd harmonic rank	
Settings	**Value**
Rank 2 function enabling	Yes / No
Rank 2 Threshold	From 20% to 70% | 1% step
Rank 2 coefficient	From 1.0 to 4.0 | 0.1 step
Rank 2 Time delay	40 ms to 2 seconds | 0.01 ms step
Closure time delay	0 to 5 s | 0.1 s step

DE-ICING FUNCTION [87L]		
Settings	**CT 5 A**	**CT 1 A**
Threshold de-icing enabling	Yes / No	
High threshold enabling	Yes / No	
Differential threshold enabling	Yes / No	
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step	
Resetting percentage	90 to 99%	
De-icing threshold	0.1 A to 8.0 A | 0.1 A step	0.02 A to 1.60 A | 0.02 A step
High threshold	0.5 A to 20.0 A | 0.1 A step	0.1 A to 4.00 A | 0.1 A step
De-icing switched	0.1 A to 8.0 A | 0.1 A step	0.02 A to 1.60 A | 0.02 A step
High switched	0.5 A to 20.0 A | 0.1 A step	0.1 A to 4.00 A | 0.1 A step
Differential threshold	0.1 A to 2.0 A | 0.1 A step	0.02 A to 0.40 A | 0.02 A step
High threshold time delay	0.04 to 1 s | 0.01 s step	
Differential threshold time delay	0.04 to 0.5 s | 0.01 s step	

CURRENT DIRECTIONAL FUNCTION [67]		
Settings	**CT 5 A**	**CT 1 A**
Threshold low & high enabling	Yes / No	
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step	
Resetting percentage	90 to 99%	
Min Z inhibition by upstream default	Yes / No	
Low threshold	0.1 A to 8.0 A | 0.1 A step	0.02 A to 1.60 A | 0.02 A step
High threshold	0.5 A to 20.0 A | 0.1 A step	0.1 A to 4.00 A | 0.1 A step
Angle θ_1 setting	10 to 80° | 1° step	
Angle θ_2 setting	-170 to -85° | 1° step	
Alarm time delay	1 min to 10 min | 1 s step (3 min by default)	
Low threshold time delay	1 mn to 10 min | 1 s step + Alarm time delay	
High threshold time delay type	Constant, Inverse configurable *According to IEC 60255-3*: Standard inverse | Very inverse | Extremely inverse | Long time inverse *According to ANSI/IEEE C37.122-1996*: Moderate inverse | Very inverse 2 | Extremely inverse 2 *US* standard: Inverse | Short time inverse	
Constant High Threshold Time Delay	0.5 s to 5 min | 0.5 s step	
Dependent High Threshold Time Delay Coefficient	0.001 to 2.000 | 0.001 step	
Coefficient β	0.00001 to 200.000 | 0.00001 step	
Coefficient $\propto$	0.01 to 10.00 | 0.01	
Coefficient L	0 to 1.0000 | 0.0001	

POWER SWING DETECTION [51DPR]		
Settings	**Value**	**Comment**
Current Drop Amplitude	10 to 100%	Current drop confirmation threshold.
Current Drop Duration	3 to 10 | 1 step	Number of periods to confirm a current drop.
Beat number	1 to 100 | 1 step	Number of beats during the beat monitoring time delay.
K	5 to 90% | 1% step	Current dip.
Beat monitoring time delay	1 s to 100 s | 1 s step	Beat monitoring time delay.
Consecutive slow drops	3 to 15 | 1 step	Number of consecutive slow drops.
Consecutive slow increases	3 to 15 | 1 step	Number of consecutive slow increases.
Gap between drops / increases	1 to 10% | 1% step	Gap in % between drops and increases.

HARMONIC OVERVOLTAGE FUNCTION [59H]	
Settings	**Value**
Instantaneous confirmation time delay	0 to 100 ms | 1 ms step
Possible setting for 4 harmonic ranks simultaneously	
Overvoltage rank n^{th} enabling	Yes / No
n^{th} harmonic rank choice	From 11 to 21
n^{th} harmonic rank threshold	10 to 100% | 1% step
n^{th} harmonic rank time delay	0.1 s to 60 s | 0.1 s step
CB tripping by n^{th} harmonic rank	Yes / No
Resetting percentage	90 to 99% | 1% step

BREAKER FAILURE [50BF]	
Settings	**Value**
Time-delay	0.1 s to 2 s | 10 ms step
CB maintenance	
Enable CB maintenance	Yes / No
Catenary CB Alarm for kA^2 cut-off number	From 1 $(kA)^2$ to 2147483647 $(kA)^2$ $(2^{31}-1)$ | 1 $(kA)^2$ step
Feeder CB Alarm for kA^2 cut-off number	From 1 $(kA)^2$ to 2147483647 $(kA)^2$ $(2^{31}-1)$ | 1 $(kA)^2$ step
Opening CB Operation number Alarm	From 1 to 65535 $(2^{16}-1)$ | 1 step

FAULT LOCATOR [21FL] [50FL] [87FL]		
Settings		**Value**
Reclose time delay		0.1 s to 30 s | 0.1 s step
Lock time delay		From 60 s to 20 mn | 1 s step
Modelling type		Linear mode / Curve mode
Linear mode		
Linear reactance		0.1 Ω/km to 0.999 Ω/km | 0.001 Ω/km step
De-icing linear reactance		0.1 Ω/km to 0.999 Ω/km | 0.001 Ω/km step
4 configurable sections		
Protection position		0 to 1,200.0 km | 0.1 km step
Section 1 to 4	Start	0 to 1,200.0 km | 0.1 km step
	End	0 to 1,200.0 km | 0.1 km step

LOGIC SELECTIVITY FUNCTION	
Settings	**Value**
Enable function	Min Z : Logical selectivity on the 3 zones Min ∑(Z) : Logical selectivity on the 2 zones Max I : Logical selectivity threshold [51-1], [51-2], [50] Power swing detection
SL time delay	0.04 s to 1.00 s | 0.01 s step
Power swing time delay	0.1 s to 10.00 s | 0.1 s step

COMMUNICATION FUNCTION	
Settings	**Value**
Connection time out	0 to 10 s | 100 ms step
Modbus RTU	
Slave number	1 to 255
Transmission format	8-N-1 | 8-N-2 | 8-E-1 | 8-O-1
Speed transmission	9,600 / 19,200 / 38,400 / 57,600 / 115,200 Bd
Modbus TCP	
IP address	XXX.XXX.XXX.XXX
Port	1 to 65,535 (fault 502)

DISTURBANCE RECORDING	
Settings	**Value**
Short pre-time	0 s to 6 s | 0.1 s step
Long pre-time	1 s to 25 s | 1 s step
Enable according to criteria	Yes / No

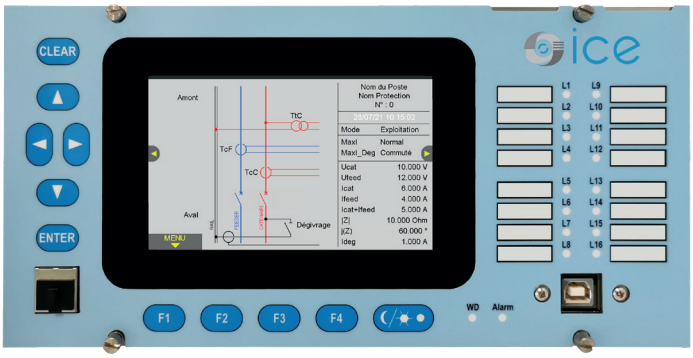
ENVIRONMENT & INFLUENCES	
Criteria	**Standards**
Product standard	
Common requirements	NF EN 60255-27
Insulation coordination	
Dielectric strength 2 kVac except COM access 500 Vac	NF EN 60255-27 NF EN 50124-1
Environmental influence tests on equipment	
Degree of protection of the enclosure IP43 on the front face, IK07	NF EN 60529 IEC 62262
Climatic environment • Operation: -5°C to +55°C • Storage : -40°C to +70°C	IEC 60068-2-1 IEC 60068-2-2
Humid atmosphere operation (40°C; 93% HR)	IEC 60068-2-78
Mechanical environment	
Vibrations 10-500 Hz • Behaviour 1 g • Endurance 2 g	IEC 60255-21-1
Shock • Behaviour 5 g-11 ms • Endurance 15 g-11 ms	IEC 60255-21-2
EMC	
Emission and immunity	IEC 60255-26 NF EN 50121-5 NF EN 61000-4-30 NF EN 61000-4-3 NF EN 61000-4-4 NF EN 61000-4-5
CE marking	
Low Voltage Directive EMC directive RoHS directive	2014/35/UE 2014/30/UE 2011/65/UE

ADVANCED CONNECTIVITY

Compliant with the requirements of the IEC 61850 edition 2 standards, our PDZI9000 relay also incorporates the following communication features:

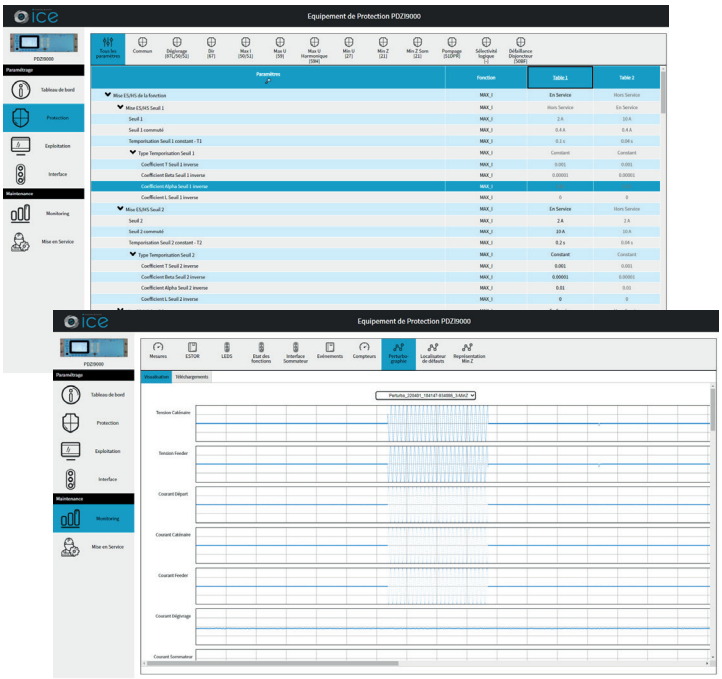
- IEC 61850-8-1 (MMS) and IEC 61850-9-2 (SV) synchronised by PTP 1588
- Modbus (serial and over TCP/IP) – 2 separate parameter sets
- Https (Configuration by Embedded Web Server)
- Time synchronisation by NTP
- Network redundancy via HSR/PRP (Option)
- SFP cage (Ethernet RJ45 reception or optic fibre choice)

HMI AND OPERATION



- 800x480 colour touch screen
- Navigation directly from the screen or via the dedicated keys
- 16 configurable LEDs

WEB INTERFACE



- Interface easily accessible with a web browser, locally via the USB type b interface or via the Ethernet port
- Convenient tool that simplifies and speeds up operations of:
  - Diagnostic
  - Setup
  - Equipment commissioning

TECHNICAL CHARACTERISTICS

Current inputs: Catenary, Feeder, Rail (3)

- Bi-calibre 1 A-5 A with short-circuiters
- Consumption at In < 0.5 VA
- Withstand a permanent 3 In and 80 In/1 s
- Measurement at ±1% from 0.1 to 4 In and ±5% from 4 to 12 In
- Working frequency between 40 and 70 Hz

Voltage inputs: Catenary and Feeder (2)

- Un 100 V or 110 V
- Withstand a permanent 1.5 Un and 1.9 Un/5 s
- Measurement at ±1% from 0.1 to 1.4 Un
- Working frequency between 40Hz and 70 Hz

Digital inputs: 18

- Proofreading of inputs status
- Power supply: 48 VDC to 125 VDC ±10%
- Current: ≥ 2mA

CB outputs: 2

- Trip relay
  - DC voltage withstand: 300 V
  - Continuous current: 16 A
  - Breaking capacity: 4,000 VA
- Output control

Digital outputs: 28

- Signalling relays
  - DC voltage: 300 V
  - Continuous current: 6 A
  - Breaking capacity: 1,500 VA
  - Max switching time: 10 ms (activation and deactivation)
- Coil/contact insulation: 4 kV
- Output control

Performance

- Instantaneous tripping time < 30ms
- Sampling rate: 6.4 kHz

Dimensions

- 19" - 3U - 355mm rack

Recordings

- 1,000 events
- 32 disturbance records in COMTRADE format

Communication protocols

- IEC 61850 edition 2
  - IEC 61850-8-1 (GOOSE, MMS)
  - IEC 618509-2 SV with IEEE 1588 PTP sync
- Network redundancy
  - PRP (Parallel Redundancy Protocol)
  - HSR (High-availability Seamless Redundancy)
- Modbus
- Configuration via HTTPS (Embedded Web server)

Power supply

- 48 V to 125 V ±10%

Operating temperature

- From –5 °C to +55 °C

Protection & Control ICE
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