TYPE DESCRIPTION

EuroProt+ Smart Line S24 - Variant 5

IED-EP+S/S24/Variant 5

TRANSFORMER DIFFERENTIAL PROTECTION RELAY

PROTECTA HUNGARY

EUROPROT+ SMART LINE S24 – VARIANT 5

TRANSFORMER DIFFERENTIAL PROTECTION RELAY

OVERVIEW

The **IED EP+ S24** Series is member of the **EuroProt+** numerical protection relay, made by Protecta Co. Ltd. The **EuroProt+** type complex protection in respect of hardware and software is a modular device. The modules are assembled and configured according to the requirements, and then the software determines the functions. The **IED EP+ S24** Series is contained a special selection of the **EuroProt+** modules, bearing in mind the cost effective realization. The **IED EP+ S24** Series is divided into several different variants corresponding to the scope of application.

The **Variant 5** is dedicated transformer protection and control IED for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industry power distribution systems

GENERAL FEATURES

- Native IEC 61850 IED with Edition 1 & 2 compatibility
- Module layouts with options
- 24 HP wide rack size (height: 3U)
- The pre-defined factory configuration can be customized to the user's specification with the powerful EuroCAP tool
- Flexible protection and control functionality to meet special customer requirements
- Different HMI Types: advanced HMI with color touchscreen and black-and-white display with 4 tactile push buttons. An embedded web server and extended measuring, control and monitoring functions are also available for both types
- User configurable LCD user screens, which can display SLDs (Single Line Diagrams) with switchgear position indication and control as well as measuring values and several types of controllable objects
- 8 setting groups available
- Enhanced breaker monitoring and control
- High capacity disturbance recorder (DRE) and event logging:
  - DRE for up to 32 analogue and 64 digital signal channels with duration up to 10s and sampling rate up to 2kHz.
  - Event recorder can store more than 10,000 events.
- Several mounting methods: Rack; Flush mounting; Semi-flush mounting; Wall mounting; Wall-mounting with terminals; Flush mounting with IP54 rated cover.
- Wide range of communication protocols:
  - Ethernet-based communication protocol: IEC61850, DNP3.0 TCP, IEC60870-5-104, Modbus TCP
  - Serial communication protocol: DNP3.0, IEC60870-5-101, IEC60870-5-103, MODBUS, SPA
- Legacy network based protocols via 100Base-FX and 10/100Base-TX (RJ45)
- Optional communication ports: Fiber optical Ethernet (MM/ST, SM/FC), RJ45, Serial POF, Serial glass fiber, RS-485/422
- Handling of several communication protocols simultaneously
- Built-in self-monitoring to detect internal hardware or software errors
- Time synchronization protocol: NTP/SNTP, Minute pulse, Legacy protocol, IRIG-B

APPLICATION

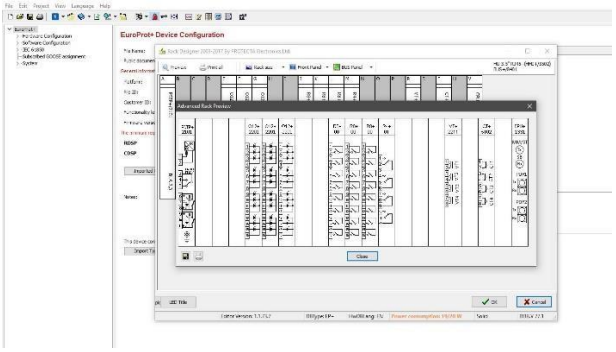
SCOPE OF APPLICATION

- Transformer differential protection for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industry power distribution systems
- Restricted earth fault protection
- Three-phase and residual overcurrent protection for both side of the transformer
- Transformer thermal protection
- Breaker failure protection function
- Current unbalance detection of CT's
- Programmable interlocking schemes

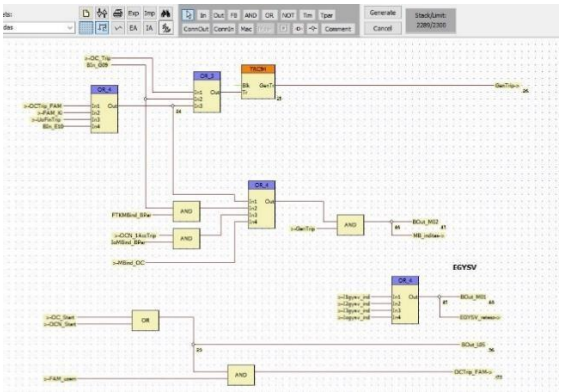
EUROCAP CONFIGURATION TOOL

The EuroCAP configuration tool, which is available free of charge, offers a user-friendly and flexible application for protection, control and measurement functions to ensure that the IED-EP+ devices are fully customisable.

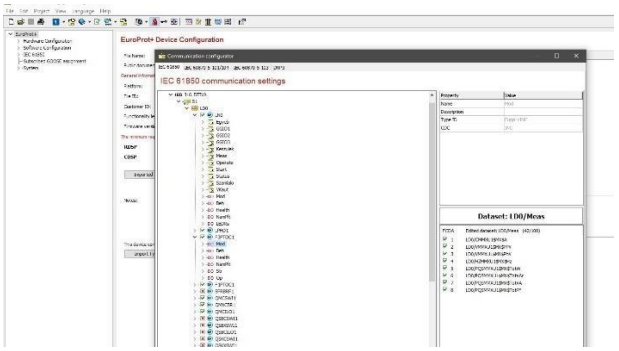
- **HW configuration**
  - View the exciting hardware configuration of the IED including card information and slot position
  - Modify (add or change) certain HW modules
  - Digital and analogue I/O signal definition



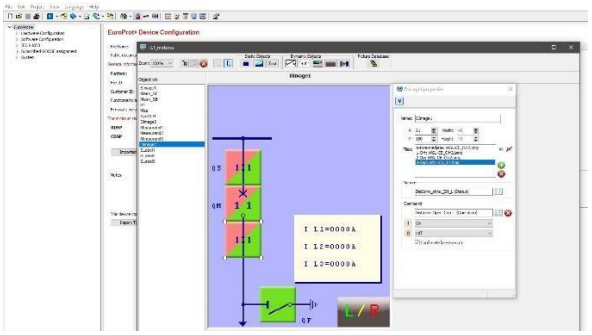
- **Logic editor**
  - Create/manage logical sheets
  - Factory pre-configured logical schemes to speed up the commissioning process



- **Communication configurator**
  - Set up IEC 61850, 101-104, 103, DNP3 communication protocols
  - Configure dataset, report and goose control block properties for IEC 61850 horizontal and vertical communication
  - GOOSE configuration between IEDs



- **LCD configurator (available with color TFT displays)**
  - Create/modify user screens with Single Line Diagrams, measuring or status values
  - Icon library for effective configuration Own, user-defined symbols can be created as well



- **Feedback documentation**

Automatic documentation of the configured IED, which can contain the actual connection assignment, on-line measurements, all recorded event channels, all recorded disturbance channels, LED assignment, Logical sheets and the relevant communication settings and collect the protection, control and monitoring parameters.

- **Offline Parameter Set Editor**
  - View, set, compare and save the setting of the IED parameters
  - Import existing parameter settings into the Offline parameter set editor from the IED
  - Import/Export parameters in xlsx format
  - Generate and save parameters in RIO/XRIO format for relay tester

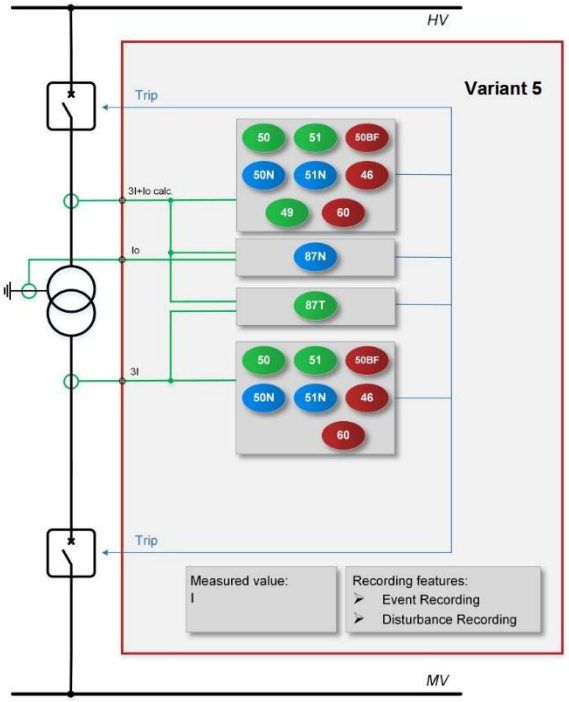
PROTECTION & CONTROL FUNCTION

The **Variant 5** configuration measures three phase currents and the zero sequence current component from both sides of a two winding, three-phase transformer. The main protection functions are transformer differential protection and restricted earth-fault protection functions.

The realized current-based protection functions, including thermal replica protection functionand differential functions, are listed in the Table below.

THE IMPLEMENTED PROTECTION & CONTROL FUNCTIONS	IEC	ANSI	*Inst.
Transformer differential protection (2W)	3IdT >	87T	1
Restricted earth-fault protection	REF	87N	2
Three-phase instantaneous overcurrent protection	I >>>	50	2
Three-phase time overcurrent protection	I >, I >>	51	6
Residual instantaneous overcurrent protection	Io >>>	50N	2
Residual time overcurrent protection	Io >, Io >>	51N	6
Negative sequence overcurrent protection	I2 >	46	1
Inrush detection	I2h >	68	1
Thermal protection	T >	49	1
Breaker failure protection	CBFP	50BF	2
Current unbalance protection		60	1

**The Inst. column contains the numbers of the pre-configured function blocks in the factory configuration. These numbers may be different in order to meet the user's requirements.*



- **Transformer differential protection (87T)**

The differential protection function provides main protection for transformers, generators or large motors, but it can also be applied for overhead lines and cables of solidly grounded networks or for the protection of any combination of the aforementioned objects.

The three-phase power transformers transform the primary current to the secondary side according to the turns ratio and the vector group of the transformers. The Y (star), D (delta) or Z (zig-zag) connection of the three phase coils on the primary and secondary sides causes the vector shift of the currents. The numerical differential protection function applies matrix transformation of the directly measured currents of one side of the transformer to match them with the currents of the other side.

In Protecta's transformer differential protection the target of the matrix transformation is the delta (D) side. Thus the problem of zero sequence current elimination in case of an external ground fault is also solved.

The method of the matrix transformation is defined by the "Code" parameter identifying the transformer vector group connection.

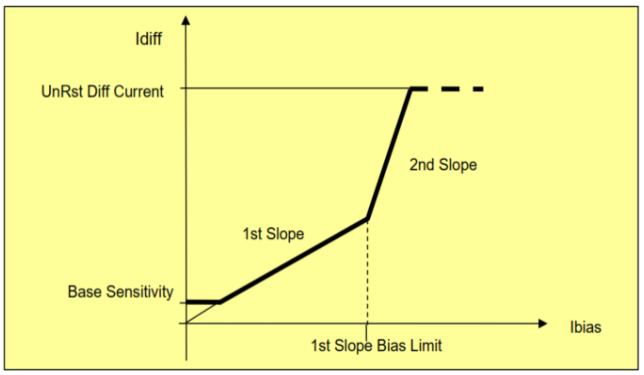
The differential current can be high during the transients of transformer energizing (inrush current) due to the current distortion caused by the transformer iron core asymmetrical saturation. In this case, the second harmonic content of the differential current is applied to disable the false operation of the differential protection function.

The differential current can be high in case of the over-excitation of the transformer due to the current distortion caused by the transformer iron core symmetrical saturation. In this case, the fifth harmonic content of the differential current is applied to disable the false operation of the differential protection function.

The harmonic analysis calculates the basic Fourier components of the three differential currents. These results are needed for the high-speed differential current decision and for the second and fifth harmonic restraint calculation.

The software modules evaluate and compare the result with the parameter values set for the second and fifth harmonic. If the harmonic content relative to the basic harmonic component of the differential currents is high, a restraint signal is generated immediately and a timer is started at the same time. If the duration of the active status is at least 25 ms, then the resetting of the restraint signal is delayed by an additional 15 ms.

The decision logic module decides if the differential current of the individual phases is above the characteristic curve of the differential protection function. It compares the magnitudes of the differential currents and those of the restraint currents for evaluation of the "percentage differential characteristics". This curve is the function of the restraint current, which is calculated based on the sum of the magnitude of the phase-shifted phase currents (see Figure below).



The characteristic curve has four sections. The first section is the base sensitivity, the second one serves to compensate the turns ratio deviation e.g. due to the operation of the on-load tap changer, the third is to eliminate false operation caused by the CT saturation and the fourth one is the unrestricted differential function.

The differential protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user applying the graphic equation editor.

- **Three-phase instantaneous overcurrent protection (50)**

The three-phase instantaneous overcurrent protection function (50) operates immediately if the phase currents are higher than the setting value. The setting value is a parameter, and it can be doubled by graphic programming of the dedicated input binary signal defined by the user. The function is based on peak value selection or on the RMS values of the Fourier basic harmonic calculation, according to the parameter setting. The fundamental Fourier components are results of an external function block.

Parameter for type selection has selection range of Off, Peak value and Fundamental value. When Fourier calculation is selected then the accuracy of the operation is high, the operation time however is above one period of the network frequency. If the operation is based on peak values then fast sub-cycle operation can be expected, but the transient overreach can be high.

The function generates trip commands without additional time delay if the detected values are above the current setting value. The function generates trip commands for the three phases individually and a general trip command as well.

The instantaneous overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

- **Three-phase time overcurrent protection (51)**

The overcurrent protection function realizes definite time or inverse time characteristics according to IEC or IEEE standards, based on three phase currents. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08. This function can be applied as main protection for medium-voltage applications or backup or overload protection for high-voltage network elements. The definite (independent) time characteristic has a fixed time delay when the current is above the starting current Is previously set as a parameter.

The binary output status signals of the three-phase overcurrent protection function are starting signals of the three phases individually, a general starting signal and a general trip command.

The overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

- **Residual instantaneous overcurrent protection (50N)**

The residual instantaneous overcurrent protection function (50N) block operates immediately if the residual current (3Io) is above the setting value. The setting value is a parameter, and it can be doubled by a dedicated binary input signal defined by the user applying the graphic programming. The function is based on peak value selection or on the RMS values of the Fourier basic harmonic component of the residual current, according to the parameter setting. The fundamental Fourier component calculation is not part of the 50N function. Parameter for type selection has selection range of Off, Peak value and Fundamental value.

The function generates a trip commands without additional time delay if the detected values are above the current setting value.

The residual instantaneous overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor

- **Residual overcurrent protection (51N)**

The residual delayed overcurrent protection function can realize definite time or inverse time characteristics according to IEC or IEEE standards, based on the RMS value of the fundamental Fourier component of a single measured current, which can be the measured residual current at the neutral point (3Io) or the calculated zero sequence current component. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08. The definite (independent) time characteristic has a fixed time delay when the current is above the starting current Is previously set as a parameter.

The binary output status signals of the residual overcurrent protection function are the general starting signal and the general trip command if the time delay determined by the characteristics expired.

The residual overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor

- **Negative sequence overcurrent protection function (46)**

The negative sequence overcurrent protection function (46) block operates if the negative sequence current is higher than the preset starting value. In the negative sequence overcurrent protection function, definite-time or inverse-time characteristics are implemented, according to IEC or IEEE standards. The function evaluates a single measured current, which is the RMS value of the fundamental Fourier component of the negative sequence current. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08. The definite (independent) time characteristic has a fixed delaying time when the current is above the starting current Gs previously set as a parameter. The negative phase sequence components calculation is based on the Fourier components of the phase currents.

The binary output status signals of the negative sequence overcurrent protection function are the general starting and the general trip command of the function.

The negative sequence overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

- **Thermal protection (49)**

Basically, thermal protection measures the three sampled phase currents. RMS values are calculated and the temperature calculation is based on the highest RMS value of the phase currents. The temperature calculation is based on the step-by-step solution of the thermal differential equation. This method yields “over temperature”, meaning the temperature above the ambient temperature. Accordingly, the temperature of the protected object is the sum of the calculated “over temperature” and the ambient temperature.

If the calculated temperature (calculated “over temperature” + ambient temperature) is above the threshold values, alarm, trip and restart blocking status signals are generated.

- **Breaker failure protection (50BF)**

After a protection function generates a trip command, it is expected that the circuit breaker opens and the fault current drops below the pre-defined normal level. If not, then an additional trip command must be generated for all backup circuit breakers to clear the fault. At the same time, if required, a

repeated trip command can be generated to the circuit breakers which are a priori expected to open. The breaker failure protection function can be applied to perform this task.

The starting signal of the breaker failure protection function is usually the trip command of any other protection function. Dedicated timer starts at the rising edge of the general start signal for the backup trip command. During the running time of the timer the function optionally monitors the currents, the closed state of the circuit breakers or both, according to the user's choice. The selection is made using an enumerated parameter.

If current supervision is selected by the user then the current limit values must be set correctly. The binary input indicating the status of the circuit breaker has no meaning.

If contact supervision is selected by the user then the current limit values have no meaning. The binary input indicating the status of the circuit breaker must be programmed correctly using the graphic equation editor.

If the parameter selection is "Current/Contact", the current parameters and the status signal must be set correctly. The breaker failure protection function resets only if all conditions for faultless state are fulfilled.

If at the end of the running time of the backup timer the currents do not drop below the pre- defined level, and/or the monitored circuit breaker is still in closed position, then a backup trip command is generated.

The pulse duration of the trip command is not shorter than the time defined by setting the parameter Pulse length.

The breaker failure protection function can be disabled by setting the enabling parameter to "Off".

Dynamic blocking (inhibition) is possible using the binary input Block. The conditions are to be programmed by the user, using the graphic equation editor.

- **Inrush detection (68)**

When an inductive element with an iron core (transformer, reactor, etc.) is energized, high current peak values can be detected. This is caused by the transient asymmetric saturation of the iron core as a nonlinear element in the power network. The sizing of the iron core is usually sufficient to keep the steady state magnetic flux values below the saturation point of the iron core, so the inrush transient slowly dies out. These current peaks depend also on random factors such as the phase angle at energizing. Depending on the shape of the magnetization curve of the iron core, the detected peaks can be several times above the rated current peaks. Additionally, in medium or high voltage networks, where losses and damping are low, the indicated high current values may be sustained at length. The function operates independently using all three phase currents individually, and additionally, a general inrush detection signal is generated if any of the phases detects inrush current.

The function can be disabled by the binary input Disable. This signal is the result of logic equations graphically edited by the user. Using the inrush detection binary signals, other protection functions can be blocked during the transient period so as to avoid the unwanted trip.

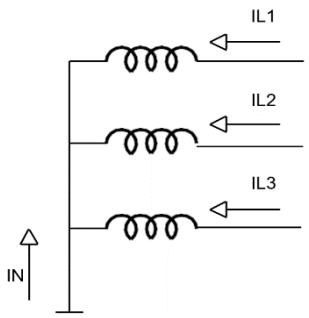
- **Current unbalance function (60)**

The current unbalance protection function (60) can be applied to detect unexpected asymmetry in current measurement. The applied method selects maximum and minimum phase currents (RMS value of the fundamental Fourier components). If the difference between them is above the setting limit, the function generates a start signal. It is a necessary precondition of start signal generation that the maximum of the currents be above 10 % of the rated current and below 150% of the rated current. The Fourier calculation modules calculate the RMS value of the basic Fourier current components of the phase currents individually. They are not part of the VCB60 function; they belong to the preparatory phase.

The decision logic module combines the status signals to generate the starting signal and the trip command of the function. The trip command is generated after the defined time delay if trip command is enabled by the Boolean parameter setting.

The function can be disabled by parameter setting, and by an input signal programmed by the user with the graphic programming tool.

- **Restricted earth fault protection (87N)**

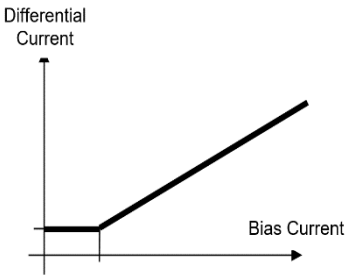


The restricted earth-fault protection function is basically a low-impedance differential protection function based on zero sequence current components. It can be applied to protect one side winding of transformers with grounded neutral against single-phase-to-earth fault (see Figure). The function compares the measured neutral current at the star point (IN) and the calculated zero sequence current component of the phase currents (IL1, IL2, IL3) and generates a trip command if the difference of these currents is above the characteristics.

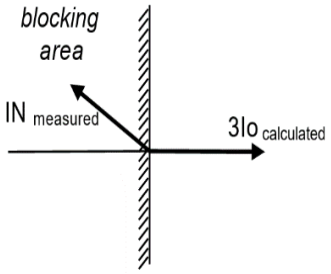
The function performs the necessary calculations for the evaluation of the "percentage differential characteristics", and decides to trip if the differential current is above the

characteristic curve of the zero sequence differential protection function. This curve is the function of the restraint (Bias) current, which is the maximum of the phase currents and the current of the neutral point.

Additionally, the function compares the direction of the neutral current and that of the calculated zero sequence current. In case of small zero sequence component of the high fault currents in the phases, this decision improves the stability of the function.



In this system, if the angle between the calculated zero sequence current 3Io and the measured neutral current IN is out of the range of ±90 degrees, then the restricted earth fault protection can be blocked (see the Figure). For the directional decision, the positive directions are drawn in Figure above. The output signal of the directional decision module can block the restricted earth-fault protection function.



A Boolean parameter of the restricted earth-fault protection function serves to enable the directional checking of the measured and calculated zero sequence currents. The restricted earth-fault protection function generates a trip signal if the differential current as the function of the bias current is above the differential characteristic lines and the function is not blocked by the directional decision. Additionally, the operation of the function is enabled by parameter setting. The conditions of enabling are defined by the user applying the graphic equation editor.

MEASUREMENTS FUNCTION

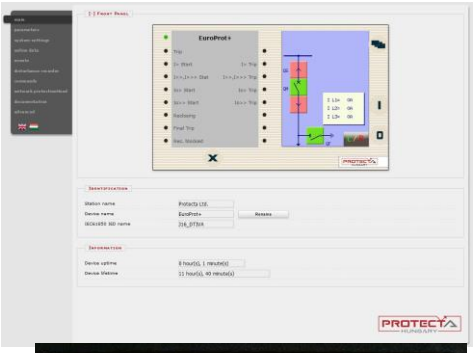
Based on the hardware inputs the measurements listed in Table below are available.

Measurement functions	Variant 5
Current (I1, I2, I3, Io)	X
Supervised trip contacts (TCS)	X

The measurement functions of the Variant 5 configuration

HMI AND COMMUNICATION TASK

- **Embedded WEB-server:**



  - Firmware upgrade possibility
  - Modification of user parameters
  - Events list and disturbance records
  - Password management
  - Online data measurement
  - Commands
  - Administrative tasks

- **Front panel HMI:**

There are two type of front panel HMI:

- **HMI+2504**:
  - 128x64pixels, black and white
  - 4 x tactile user keys
  - RJ45 10/100Mbit/s
- **HMI+2404** (optional):
  - 320 × 240 pixel TFT display with Resistive touchscreen interface
  - 4 x tactile user keys
  - RJ45 10/100Mbit/s

IED EP+S24 B&W HMI front panel

IED EP+S24 True color HMI front panel

- **Communication:**
  - The built-in 5-port Ethernet switch allows EuroProt+ to connect to IP/Ethernet-based network. The following Ethernet ports are available:
    - Station bus (100Base-FX Ethernet) SBW
    - Redundant station bus (100Base-FX Ethernet) SBR
    - Proprietary process bus (100Base-FX Ethernet)
    - RJ-45 Ethernet user interface
    - Optional 10/100Base-T port via RJ-45 connector
  - PRP/HSR seamless redundancy for Ethernet networking (100Base-FX Ethernet)
  - Other communication:
    - RS422/RS485 interfaces (galvanic interface to support legacy or other serial protocols, ASIF)
    - Plastic or glass fiber interfaces to support legacy protocols, ASIF

Transformer differential protection (87T)	
Operation	Off, On
Pri-Sec VGroup	Dy1, Dy5, Dy7, Dy11, Dd0, Dd6, Dz0, Dz2, Dz4, Dz6, Dz8, Dz10, Yy0, Yy6, Yd1, Yd5, Yd7, Yd11, Yz1, Yz5, Yz7, Yz11
Pri-Ter VGroup*	Dy1, Dy5, Dy7, Dy11, Dd0, Dd6, Dz0, Dz2, Dz4, Dz6, Dz8, Dz10, Yy0, Yy6, Yd1, Yd5, Yd7, Yd11, Yz1, Yz5, Yz7, Yz11
	False, True
	20-500% in 1% step
Zero Seq Elimination	20-500% in 1% step
TR Primary Comp	20-200% in 1% step
TR Secondary Comp	5-50% in 1% step
TR Tertiary Comp	5-50% in 1% step
2nd Harm Ratio	10-50% in 1% step
5th Harm Ratio	10-50% in 1% step
Base Sensitivity	200-2000% in 1% step
1st Slope	800-2500% in 1% step
1st Slope Bias Limit	
UnRst Diff Current	
Three-phase instantaneous overcurrent protection (50)	
Operation	Off, Peak value, Fundamental value
Start current	5-3000% in 1% steps
Three-phase time overcurrent protection (51)	
Operation	Off, Definite Time, IEC Inv, IEC VeryInv, IEC ExtInv, IEC LongInv, ANSI0.95 Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv
Start current	5-3000% in 1% steps
Time Multiplier	0.05-999 in 0.01 steps
Minimum time delay for the inverse char.	40-60000ms in 1ms steps
Definite time delay for definite type char.	40-60000ms in 1ms steps
Reset time delay for the IEC type inverse char.	60-60000ms in 1ms steps
Residual instantaneous overcurrent protection (50N)	
Operation	Off, Peak value, Fundamental value0.85
Start Current	5-3000% in 1% steps
Residual time overcurrent protection (51N)	
Operation	Off, DefiniteTime, IEC Inv,IEC VeryInv, IEC ExtInv,IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv
Start current	
In = 1A or 5A	5-3000% in 1% steps
In = 200mA or 1A	5-3000% in 1% steps
Time Multiplier	0.05-999 in 0.01 steps
Minimum time delay for the inverse char.	40-60000ms in 1ms steps
Definite time delay for definite type char.	40-60000ms in 1ms steps
Reset time delay for the inverse char.	60-60000ms in 1ms steps
Negative sequence overcurrent protection (46)	

Operation	Off, DefiniteTime, IEC Inv,IEC VeryInv, IEC ExtInv,IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv
Start Current	5-3000% in 1% steps
Time Multiplier	0.05-999 in 0.01 steps
Minimal time delay for the inverse char.	0-60000ms in 1ms steps
Definite time delay	0-60000ms in 1ms steps
Reset time delay for the inverse char	0-60000ms in 1ms steps
Thermal protection (49)	
Operation	Off, Pulsed, Locked
Alarm Temperature	60-200deg in 1deg steps
Trip Temperature	60-200deg in 1deg steps
Rated Temperature	60-200deg in 1deg steps
Base Temperature	0-40deg in 1deg steps
Unlock Temperature	20-200deg in 1deg steps
Ambient Temperature	0-40deg in 1deg steps
Startup Term	0-60% in 1% steps
Rated Load Current	20-150% in 1% steps
Time Constan	1-999min in 1min step
Breaker failure protection (50BF)	
Operation	Off, Current, Contact, Current/Contact ±5 ms
Start Ph Current	20-200% in 1% steps
Start Res Current	10-200% in 1% steps
Backup Time Delay	60-1000ms in 1ms steps
Pulse Duration	0-60000ms in 1ms steps
Inrush detection (68)	
Operation	Off, On
2nd Harm Ratio	5-50% in 1% steps
Basic sensitivity of the function	20-100% in 1% steps
Current unbalance protection (60)	
Operation	Off, On
Start Signal Only	False, True
Start Current Diff	10-90% in 1% steps
Time Delay	100-60000ms in 1ms steps
Rectricted earth fault protection function (87N)	
Operation	Off, On
Directional check	False, True
Io Primary Match	20-500% in 1% steps
Neutral Match	100-1000% in 1% steps
Base Sensitivity	10-50% in 1% steps
Slope	50-100% in 1% steps
Base Sens Bias Limit	100-200% in 1% steps

TECHNICAL DATA

HARDWARE	
Analog Inputs (Current Input Modules)	
Rated current In	1A or 5A (selectable)
Rated frequency	50Hz or 60Hz
Overload rating	20A continuous, 175A for 10s, 500A for 1s, 1200A for 10ms
Burden	0.01VA at In = 1A, 0.25VA at In = 5A
Power Supply	
Rated auxiliary voltage	24/48/60VD (Operative range: 19.2 -72Vdc) 110/220Vdc (Operative range: 88 - 264Vdc or 80-250Vac)
Power consumption	20W
Binary Inputs	
Input circuit DC voltage	24VDC (Thermal withstand voltage: 72VDC) 48VDC (Thermal withstand voltage: 100VDC) 110VDC (Thermal withstand voltage: 250VDC) 220VDC (Thermal withstand voltage: 320VDC)
Pickup voltage	0.8Un
Drop voltage	0.64Un
Power consumption	max. 1.6 mA per channel at 220VDC max. 1.8 mA per channel at 110VDC max. 2 mA per channel at 48VDC max. 3 mA per channel at 24VDC
Binary Outputs	
Rated voltage	250VAC/DC
Continuous carry	8A
Maximum switching voltage	400VAC
Breaking capacity	(L/R=40 ms) 0.2A at 220VDC, 0.3A at 110VDC 2000VA max
Short time carrying capacity	35A for 1s
Operating time	Typically 10ms
Mechanical Design	
Installation	Flush mounting
Case	24 HP (height:3U)
Protection class	IP4x from front side, IP2x from rear side IP54 Rated mounting kit
Key & LED	
Device keys	Capacitive touch keys
Capacitive touch key LEDS	4 pcs yellow, 3 mm circular LEDs indicating touch key actions
Number of configurable LED	16
Device status LED	1 piece three-color, 3 mm circular LED Green: normal device operation Yellow: device is in warning state Red: device is in error state
Local Interface	
Service port on front panel	10/100-Base-T interface with RJ-45 type connector

System Interface	
10/100-Base-TX	IP56 rated with RJ-45 connector
100Base-FX	MM/ST 1300 nm, 50/62.5/125 µm connector, (up to 2 km) fiber
	SM/FC 1550 nm, 9/125 µm connector, (up to 120 km)
	SM/FC 1550 nm, 9/125 µm connector, (up to 50 km)
	MM/LC 1300 nm, 50/62.5/125 µm connector, (up to 2 km) fiber
Serial Interface	Plastic optical fiber (ASIF-POF)
	Glass with ST connector (ASIF-GS)
	Galvanic RS485/422 (ASIF-G)
PROTECTION & CONTROL FUNCTION	
Transformer differential protection (87T)	
Operating characteristic	2 breakpoints
Reset ratio	0.95
Characteristic accuracy	<2%
Operate time, unrestrained	Typically 20 ms
Reset time, unrestrained	Typically 25 ms
Operate time, restrained	Typically 30 ms
Reset time, restrained	Typically 25 ms
Three-phase instantaneous overcurrent protection (50)	
Using peak value calculation	
Operating characteristic	Instantaneous, accuracy < 6 %
Reset ratio	0.85
Operate time at $2*I_S$	<15 ms
Reset time	<40 ms
Transient overreach	90%
Using Fourier basic harmonic calculation	
Operating characteristic	Instantaneous, accuracy < 2 %
Reset ratio	0.85
Operate time at $2*I_S$	<25 ms
Reset time	<60 ms
Transient overreach	15%
Three-phase time overcurrent protection (51)	
Operating accuracy	<2% (when $20 \leq G_S \leq 1000$)
Operate time accuracy	±5% or ±15 ms, whichever is greater
Reset ratio	0.95
Reset time	
Dependent time char.	Dependent time char.
Definite time char.	Approx 60 ms
Reset time accuracy	< 2% or ±35 ms, whichever is greater
Transient overreach	< 2 %
Pickup time	< 40 ms
Overshot time	
Dependent time char.	30ms
Dependent time char.	50 ms
Influence of time varying value of the	< 4 %

input current (IEC 60255-151)	
Residual instantaneous overcurrent protection (50N)	
Using peak value calculation	
Operating characteristic (I>0.1 In)	Instantaneous, accuracy <6%
Reset ratio	0.85
Operate time at 2*I_S	< 15 ms
Reset time *	< 35 ms
Transient overreach	85 %
Using Fourier basic harmonic calculation	
Operating characteristic (I>0.1 In)	Instantaneous, accuracy <6%
Reset ratio	0.85
Operate time at 2*I_S	< 25 ms
Reset time *	< 60 ms
Transient overreach	15 %
Residual time overcurrent protection (51N)	
Operating accuracy	<3% (when 20 ≤ G_S ≤ 1000)
Operate time accuracy	±5% or ±15 ms, whichever is greater
Reset ratio	0.95
Reset time	
Dependent time char.	Dependent time char.
Definite time char.	Approx 60 ms
Reset accuracy time	< 2% or ±35 ms, whichever is greater
Transient overreach	< 2 %
Pickup time *	≤ 40 ms
Overshot time	
Dependent time char.	30 ms
Definite time char.	50 ms
Influence of time varying value of the input current (IEC 60255-151) accuracy	< 4 %
Negative sequence overcurrent protection (46)	
Operating accuracy	< 2% (when 20 ≤ G_S ≤ 1000)
Operate time accuracy	±5% or ±15 ms, whichever is greater
Reset ratio	0.95
Reset time	
Dependent time char.	Dependent time char.
Definite time char.	Approx 60 ms
Reset accuracy time	< 2% or ±35 ms, whichever is greater
Transient overreach	< 2 %
Pickup time *	< 40 ms
Overshot time	
Dependent time char.	25 ms
Definite time char.	45 ms
Influence of time varying value of the input current (IEC 60255-151) accuracy	< 4 %
Thermal protection (49)	
Operate time at I>1.2*Itrip accuracy	<3 % or <+ 20 ms

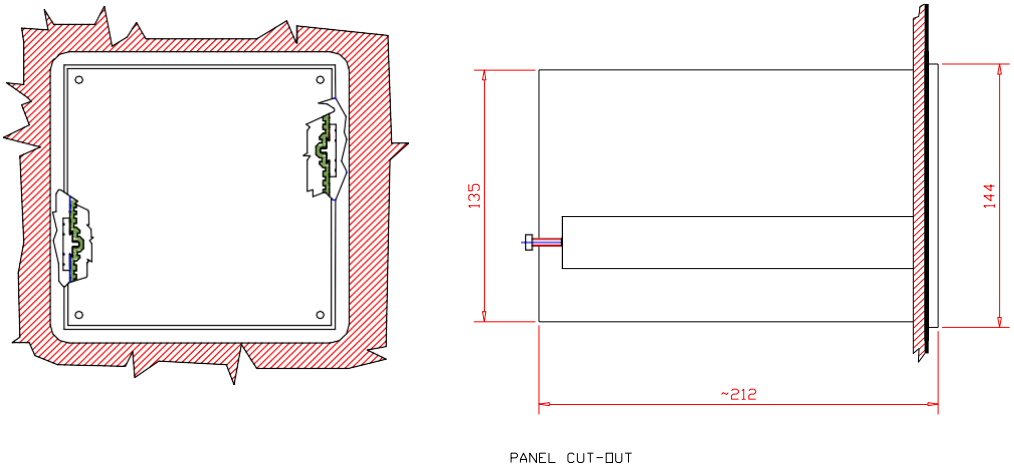
Breaker failure protection (50BF)	
Current accuracy BF Time accuracy Current reset time	<2 % ±5 ms 20 ms
Inrush detection (68)	
Range Current accuracy	20 – 2000% of In ±1% of In
Current unbalance protection (60)	
Pick-up starting accuracy at In Reset ratio Operate time	Pick-up starting accuracy at In 0.95 70 ms
Rectricted earth fault protection function (87N)	
Operating characteristic Reset ratio Characteristic accuracy Opera time, restrained Reset time, restrained	1 breakpoint 0.95 <2% Typically 20ms Typically 25ms
MEASUREMENT FUNCTION	
Current With CT/5151 or CT/5102 modules With CT/1500 modules	 Range: 0.2-0.5In, accuracy: ±2%, ±1 digit Range: 0.5-20In, accuracy: ±1%, ±1 digit Range: 0.03-2In, accuracy: ±0.5%, ±1 digit

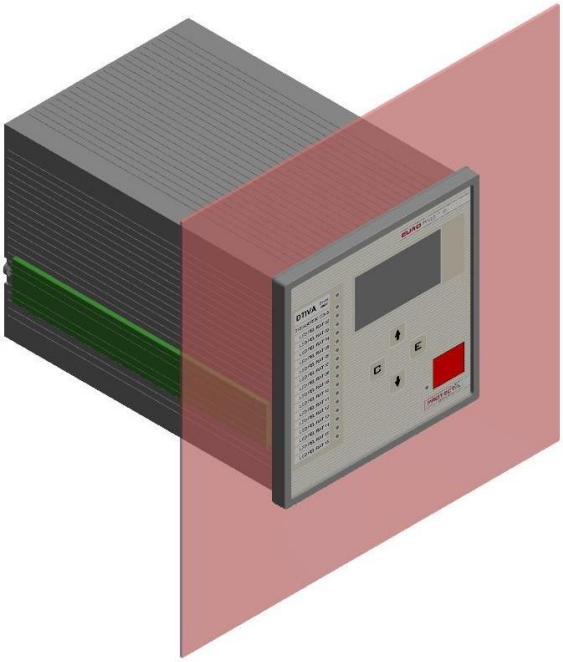
ENVIRONMENTAL PERFORMANCE

Atmospheric Environment		
Temperature	IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14	Storage temperature: - 40 ºC … + 70 ºC Operation temperature: 20 ºC … + 55 ºC
Humidity	IEC 60255-1 IEC 60068-2-78	Humidity: 10 % ... 93 %
Enclosure protection	IEC 60529	IP4x from front side, IP2x from rear side IP54 Rated mounting kit
Mechanical Environment		
Vibration	IEC 60255-21-1	Class I
Shock and bump	IEC 60255-21-2	Class I
Seismic	IEC 60255-21-3	Class I
Electrical Environment		
Dielectric withstand	IEC 60255-27	Test levels: 2 kV AC 50 Hz (0.705 kV DC for transducer inputs)
High voltage impulse	IEC 60255-27	Test levels: 5 kV (1 kV for transducer and temperature measuring inputs)
Insulation resistance	IEC 60255-27	Insulation resistance > 15 GΩ
Voltage dips, interruptions, variations and ripple on dc supply	IEC 60255-26	Voltage dips: 40 % (200 ms), 70 % (500ms), 80 % (5000 ms)
Thermal short time	IEC 60255-27	
Electromagnetic Environment		
Electrostatic discharge	IEC 61000-4-2 IEC 60255-26	Test voltages: 15 kV air discharge, 8 kV contact discharge
Radiated radio frequency electromagnetic field immunity	IEC 61000-4-3 IEC 60255-26	Test field strength: 10 V/m
Electrical fast transient	IEC 61000-4-4 IEC 60255-26	Test voltage: 4 kV, 5kHz
Surge immunity	IEC 61000-4-5 IEC 60255-26	Test voltages: 4 kV line-to-earth, 2 kV line-to-line
Immunity to conducted disturbances, induced by radio-frequency fields	IEC 61000-4-6 IEC 60255-26	Frequency sweep: 150kHz…80 MHz Spot frequencies: 27 MHz, 68 MHz Test voltage: 10 V
Power frequency magnetic field immunity	IEC 61000-4-8 IEC 60255-26	Test field field strength: 100 A/m continuous, 1000 A/m for 3 s
Damped oscillatory wave immunity	IEC 61000-4-18 IEC 60255-26	Test frequency: 100 kHz, 1 MHz Test voltage: 2.5 kV in common mode, 1 kV in

		differential mode

- **Flush mounting of 24HP panel instrument case**

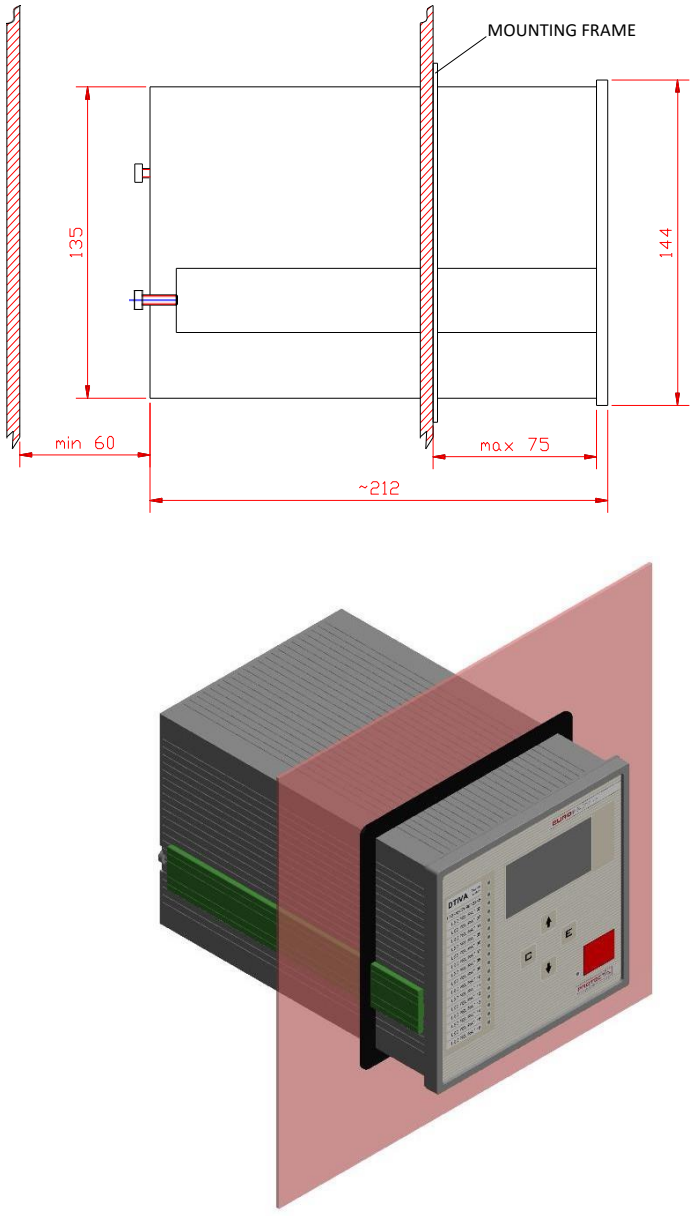




S24 Series flush mounting method

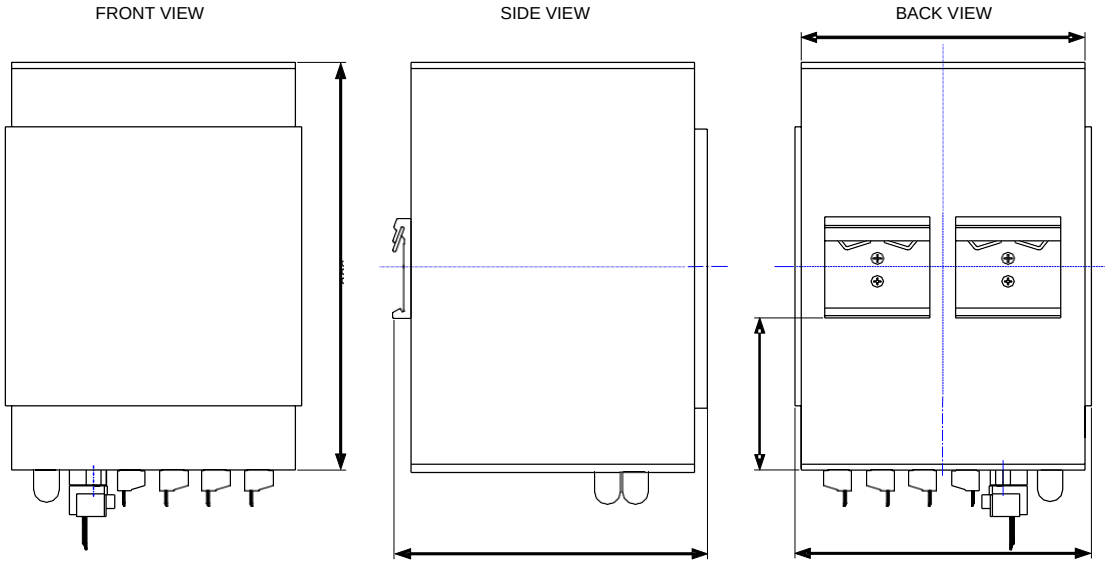
- **Semi-flush mounting of 24HP panel instrument case**

The dimensions of the panel cut-out for this type of mounting method are the same as in case of flush mounting (138 mm × 138 mm). For semi flush mounting you only have to cut in two the fixing elements (with green colour in the 3D illustration below) and make the assembly as you can see in the pictures below



S24 Series Semi-flush mounting method

- **Din rail mounting of 24HP panel instrument case**



S24 Series din rail mounting method

HARDWARE CONFIGURATION

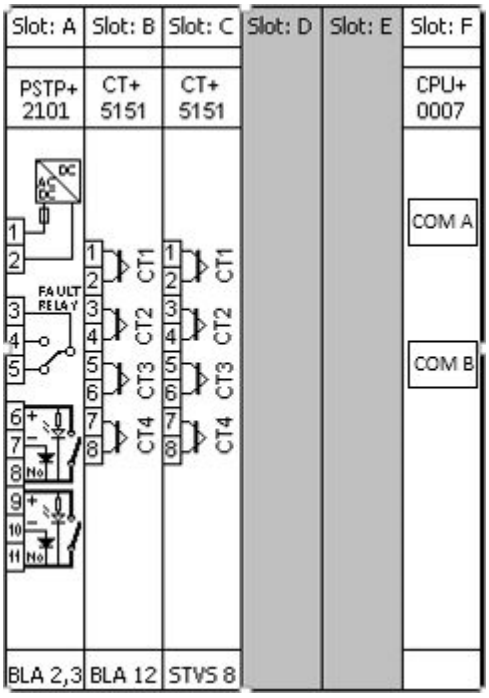
- **I/O configuration**

The standard number of inputs and outputs of each variant are listed in the table below

Hardware configuration	Variant 5
Current inputs (4th channel can be sensitive)	8
Digital inputs	12*
Digital outputs	8*
Fast trip outputs	2*

* as standard I/O card hardware configuration. The number of digital input, digital output, fast trip output can be selected as optional (I/O card option)

- **Module arrangement**



Basic module arrangement of the Variant 5 configuration (24TE, rear view)

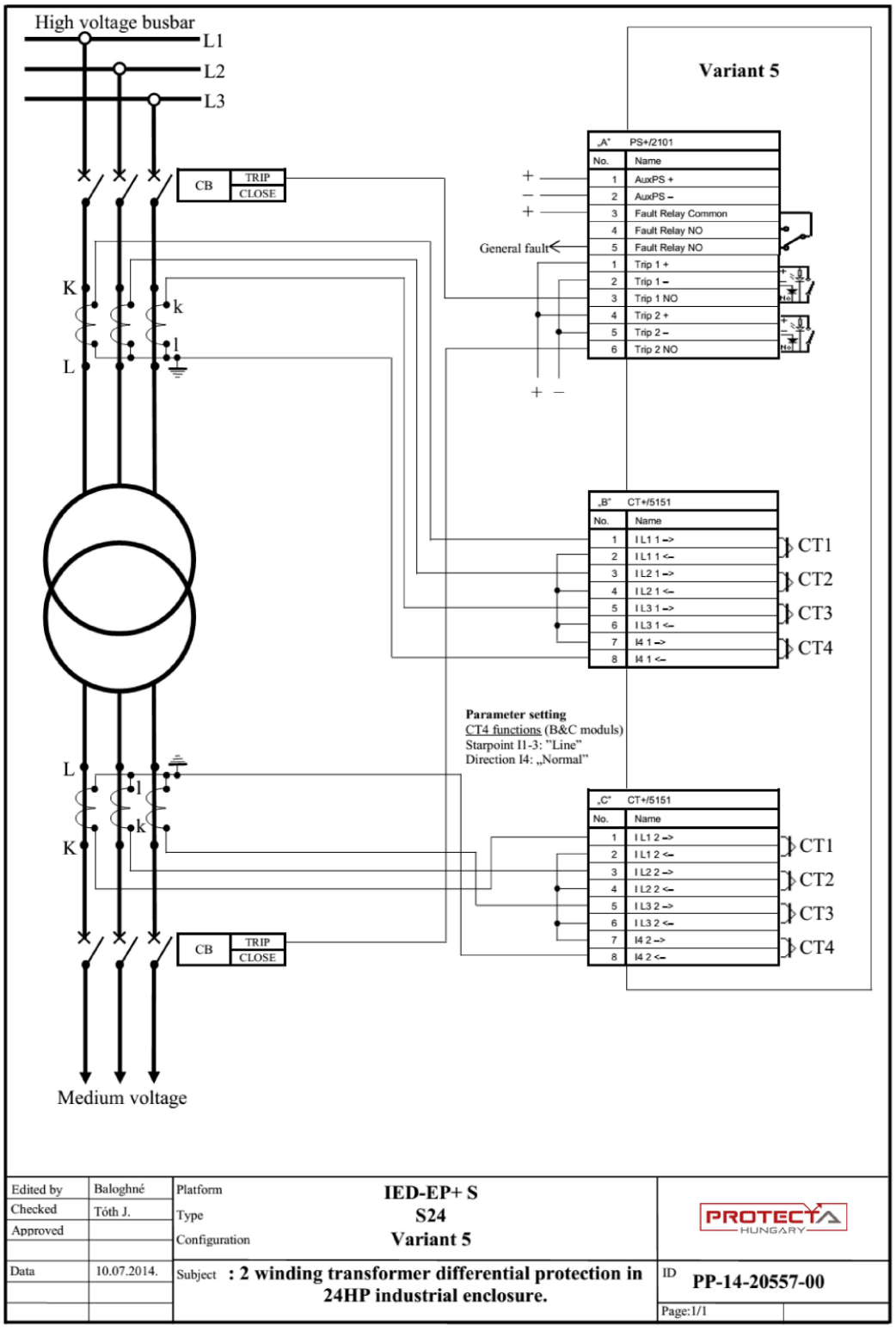
- I/O card options for slot D and slot E

IO card type	Slot D	Slot E
O6R5	Standard	N/A
O12	Option	Option
O8	Option	Option
R8	Option	Option

- I/O card type:
  - O6R5: I/O Card with 6 digital inputs and 5 digital outputs
  - O12: I/O Card with 12 digital inputs
  - O8: I/O Card with 8 digital inputs
  - R8: I/O Card with 8 digital inputs

EXTERNAL CONNECTION DIAGRAM

- **S24 Series Variant 5**



Typical connection diagram for the Variant 5

CONTACT

For more information, please refer to the **S24 Series Variant 5** configuration description document or contact us:

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