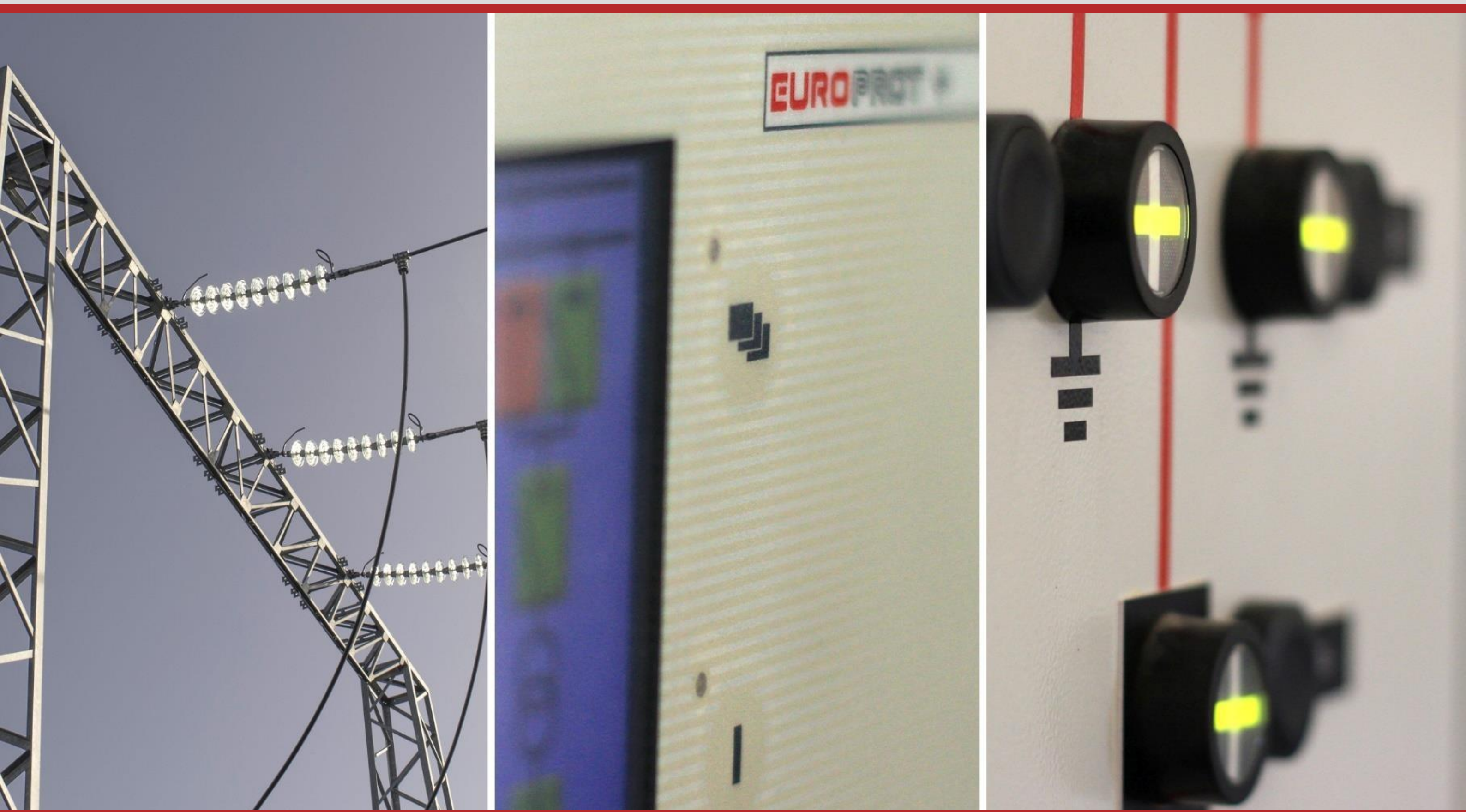


PRODUCT DESCRIPTION

EuroProt+ OGYD/DGYD

IED-EP+/OGYD & IED-EP+/DGYD

BUSBAR DIFFERENTIAL PROTECTION RELAY

PROTECTA HUNGARY

EUROPROT+ OGYD/DGYD

BUSBAR DIFFERENTIAL PROTECTION RELAY

OVERVIEW

The **OGYD** and **DGYD** product types are members of the **EuroProt+** numerical protection relay, made by Protecta Co. Ltd. The **EuroProt+** 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.

Protecta offers two different types of busbar protection. Essentially, both work on the well-known principle: the sum of the currents flowing into and out of the busbar results zero if there are no internal faults. If the sum is not zero, there is an internal fault and a fast trip command is generated. The scheme in both versions is the low-impedance, biased differential scheme, the application of Kirchhoff`s node law.

- **Distributed (Decentralized) version - OGYD**

In this version other individual protective devices of the bays (distance protection, overcurrent protection, etc., or potentially dedicated bay units) are involved in the busbar protection scheme as bay units. Their location in the substation depends on the bay structure of the primary system. These devices perform the sampling of the currents and they have access to all information needed for the busbar protection system. This information is sent by a fiber optic link to the central unit. The calculation and decision are performed by the central unit and the dedicated trip commands are sent back to the devices also via fiber optic links.

The bay units can perform any other protection function, but they communicate binary information with the device via fiber optic links. The bay unit can be feeder protection relay with optional decentralized busbar protection sub-unit application such as: DTIVA (DTIVA/E1-Feeder; DTIVA/E2-Feeder,...DTIVA/E7-Feeder), DTVA (DTVA/E1-Line, DTVA/E2-Line),…

- **Centralized version - DGYD**

In this version if the number of bays connected to the busbar is limited (there are a maximum of 8 bays), the tasks related to the three-phase busbar differential protection function are performed within one device. If there are more bays, the tasks are divided among three independent devices. Each of them is responsible for the differential protection of one phase (L1, L2 or L3) of the busbar. The calculation and decision are performed by the central unit and the dedicated trip commands are sent directly to circuit breakers in each bay.

GENERAL FEATURES

- Native IEC 61850 IED with Edition 1 & 2 compatibility
- Module layouts with options 42 or 84 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 setting values, measurement values, event and fault information (timestamp, function block, fault phase, fault current...)
- 8 setting groups available as default. The number of setting group can be up to 20 as user's requirement.
- Enhanced breaker monitoring and control
- High capacity disturbance recorder (DRE) and event logging in non-volatile memory:
  - DRE can store more than 64 records
  - Each DRE recording can be configured 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
  - The records can be read out from IED in the standard COMTRADE file format (IEEE Std C37.111) via exist communication connection (such as IEC61850) or even examined on-line. Every single record stored in 3 files with the same name and the following extensions: .dat, .cfg, .inf
- 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 Ethernet (MM/ST, SM/FC), RJ45, Serial POF, Serial glass fiber, RS-485/422
- Handling 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
- Integrated advanced cyber security - Conformity with the Cyber Security requirements in accordance with NERC-CIP, IEEE 1686, BDEW Whitepaper and IEC 62351-8 standard and recommendation. Passwords are required when logging into the device for: access, control, setting, manage,...

APPLICATION

The **OGYD** product type is designed specifically to be the main unit of a distributed low-impedance busbar protection system to protect bus schemes up to 30 bays.

The **DGYD** type performs fast and stable centralized low-impedance busbar protection in transmission and utility systems, up to 24 bays (for single phase) and up to 8 bays (for 3 three phase)

SCOPE OF APPLICATION

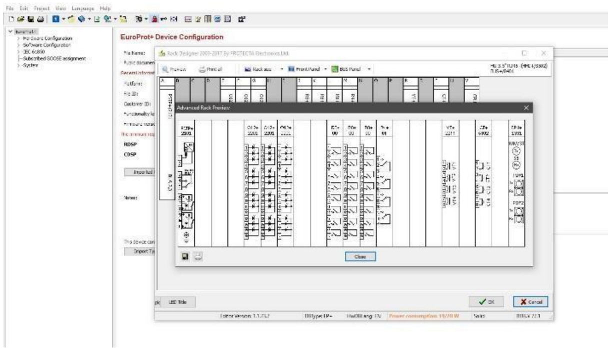
- Dynamic busbar replica, based on disconnector status signals
- High stability in case of external faults in spite of current transformer saturation
- Short tripping time
- Selectivity for internal fault, only the bays connected to the faulty busbar section are disconnected, all other bays remain in continuous operation
- Easy to extend according to the busbar
- Easy adaptation of the function for different primary bus systems:
  - Single busbar
  - Up to quadruple busbar
  - Ring bus
  - 1 ½ circuit breaker arrangement
  - Bus couplers
  - Bus sectionalizers with one or two current transformers
  - Transfer bus
- Individual numerical calculation and decision for all three phases
- Stabilized differential current characteristics
- Security and stability are increased through special software features:
  - Voltage breakdown condition
  - Implemented Check zone criteria to increase stability
  - Saturated waveform compensation

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.

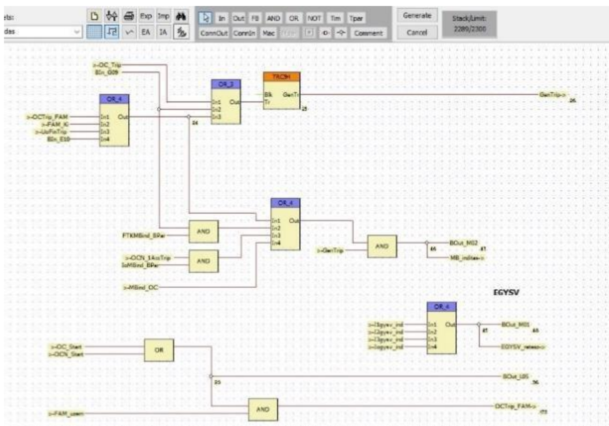
- **HW configuration**

- 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



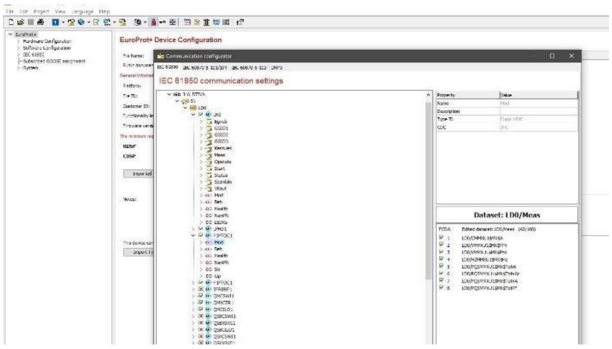
- **Logic editor**

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



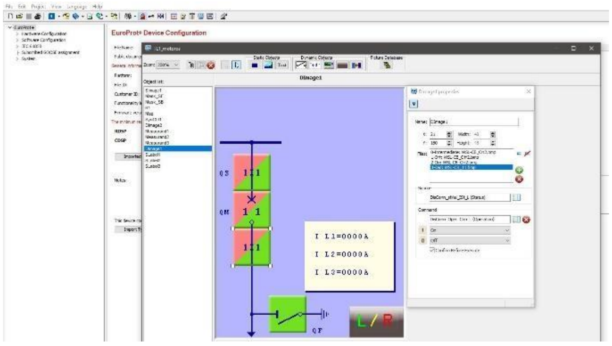
- **Communication configurator**

- 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 format for relay tester. The XRIO files can be downloadable from website

PROTECTION & CONTROL FUNCTION

All members of the decentralized **OGYD** type have the same functionality: the low-impedance distributed busbar protection. The difference between them is in the number of the protected sub-units (i.e. the number of the COM modules that communicate with the bay units). The currently available configurations of the **OGYD** type are listed in the table below (the list may grow over time).

VARIANT	MAIN APPLICATION
E1-DBBP	Distributed busbar protection for 3 bays (sub-units)
E2-DBBP	Distributed busbar protection for 6 bays (sub-units)
E3-DBBP	Distributed busbar protection for 9 bays (sub-units)
E4-DBBP	Distributed busbar protection for 12 bays (sub-units)
E5-DBBP	Distributed busbar protection for 15 bays (sub-units)
E6-DBBP	Distributed busbar protection for 18 bays (sub-units)
E7-DBBP	Distributed busbar protection for 21 bays (sub-units)
E8-DBBP	Distributed busbar protection for 24 bays (sub-units)
E10-DBBP	Distributed busbar protection for 30 bays (sub-units)

There are two groups of members in the **DGYD** type, all of them realizing low-impedance centralized busbar protection. The first of them handles all three phases of each protected bay (name starting with '**E3**', see below). The second group has the same functionality, but here one device handles only one phase of each bay (name starting with '**E1**'). This way more bays can be handled with centralized busbar protection function. This also means that to handle all three phases will require three devices. The difference between each member is the number of the handled bays (i.e. the number of the contained CT inputs for the bays). The available configurations of the **DGYD** type are listed in the table below (the list may grow over time).

VARIANT	MAIN APPLICATION
E33-CBBP	Centralized three-phase busbar protection for 3 bays
E34-CBBP	Centralized three-phase busbar protection for 4 bays
E35-CBBP	Centralized three-phase busbar protection for 5 bays
E36-CBBP	Centralized three-phase busbar protection for 6 bays
E38-CBBP	Centralized three-phase busbar protection for 8 bays
E11-CBBP	Centralized single-phase busbar protection for 15 bays
E14-CBBP	Centralized single-phase busbar protection for 18 bays
E15-CBBP	Centralized single-phase busbar protection for 21 bays
E16-CBBP	Centralized single-phase busbar protection for 24 bays

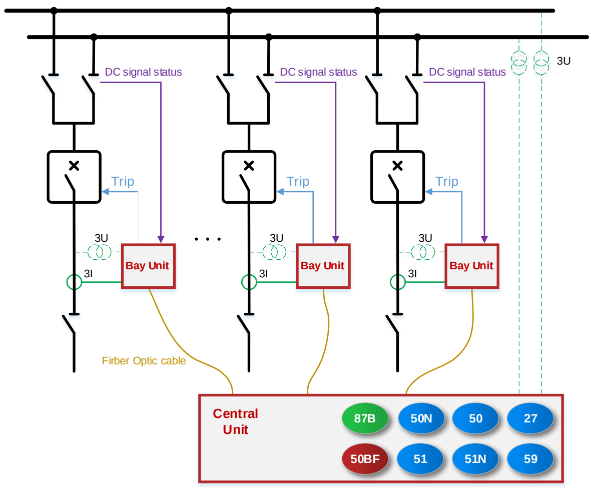
For both **OGYD** and **DGYG**, the numerical protection integrates two independent protection functions:

- Numerical differential protection
- Breaker failure protection.

These functions are discussed together because breaker failure protection utilizes the processed status information of the busbar protection to disconnect only the section of the busbar to which the faulty circuit breaker is connected. Consequently, other zones may remain in continuous service.

- **OGYD: Decentralized Busbar Differential Protection**

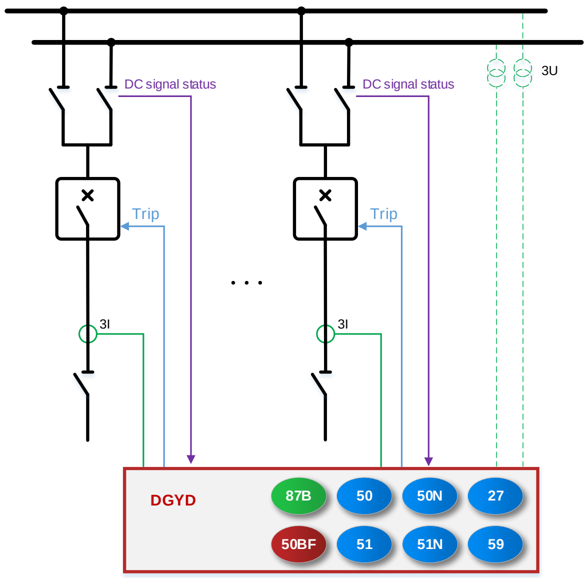
THE IMPLEMENTED PROTECTION & CONTROL FUNCTIONS	IEC	ANSI	*Inst.
Busbar differential protection	3IdB>	87B	1
Breaker failure protection	CBFP	50BF	1
Trip circuit supervision		74	1
Lockout trip logic function		86/94	1
Three-phase instantaneous overcurrent protection function	I>>>	50	Op.
Residual instantaneous overcurrent protection function	Io>>>	50N	Op.
Three-phase time overcurrent protection function	I>, I>>	51	Op.
Residual overcurrent protection function	Io>, Io>>	51N	Op.
Definite time undervoltage protection	U <, U <<	27	Op.
Definite time overvoltage protection	U >, U >>	59	Op.



**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.*

- **DGYD: Central Busbar Differential Protection**

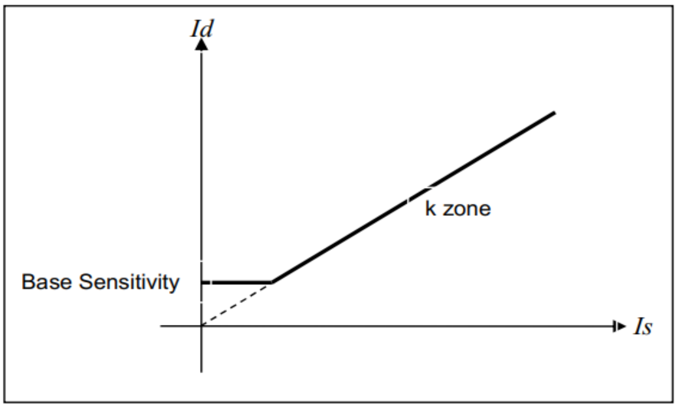
THE IMPLEMENTED PROTECTION & CONTROL FUNCTIONS	IEC	ANSI	*Inst.
Busbar differential protection	3IdB>	87B	1
Breaker failure protection	CBFP	50BF	1
Trip circuit supervision		74	1
Lockout trip logic function		86/94	1
Three-phase instantaneous overcurrent protection function	I>>>	50	Op.
Residual instantaneous overcurrent protection function	Io>>>	50N	Op.
Three-phase time overcurrent protection function	I>, I>>	51	Op.
Residual overcurrent protection function	Io>, Io>>	51N	Op.
Definite time undervoltage protection	U <, U <<	27	Op.
Definite time overvoltage protection	U >, U >>	59	Op.



**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.*

- **Busbar differential protection function and breaker failure protection**

- **The differential characteristics:** the trip characteristic for a measuring element is shown in the Figure below.



In case of detected through fault, the slope of the characteristic is dynamically changed to 90%. When tested, the applied method results a constant 90% measured value for the slope.

In case of external fault however, the locus of the Id-Is points on the plane of the differential characteristics start moving in the direction of the Is axis. If the algorithm recognizes this movement, i.e. the locus is below the line described by the slope "k" then the number of the required check points gets a high value. This extended checking period does not permit trip command generation during the time period, when the iron core of the overloaded current transformer gets saturated, and it cannot deliver proportional secondary current for the measurement.

- **Voltage breakdown condition (ordering option):** In case of current transformer circuit error, the missing current from any of the bays, the measuring element detects current difference. This could result a trip command to the bus section. To prevent this kind of operation error, the trip command is released only if in the affected bus section the voltage collapses.

To perform this supervision, the presence of the voltage is monitored with a quick voltage measuring function. The result of the supervision is considered in every millisecond. If before increasing the current, the voltage is in the range of the normal operating voltage (above approximately 0.6Un), and then during a fault any of the phase voltages is below 0.6Un, the function enables the operation of the differential protection function. If the currents fulfill the differential criteria, the algorithm generates a trip command. If the differential protection function started and any of the bay units received trip command then this voltage condition does not play any role. The trip command resets only if the currents are outside the tripping zone of the characteristics.

A voltage monitoring function can allow trip command only for 0.5 s, then the function is disabled until the measured voltage returns to healthy state again, or a new initializing is performed (caused by disconnector status change, switching on or off, parameter changes).

If all voltage monitoring functions assigned to a measuring element detect low voltage then the bus-bar section is considered to be disconnected, and the operation of the bus-bar differential protection is enabled again (to cover the switch-on-to-fault condition).

The parameters for the voltage breakdown condition are fix values (0.6Un), the function does not need any parameter setting.

- **The check zone:** If any of the status signals received from the bays is wrong then the false operation based on this wrong signal could disconnect the bus section. To avoid this kind of errors the "check zone" is applied. This additional "check zone measuring element" supposes the whole busbar system as a single node. It gets all current samples from the bays except those sampled from the current transformers connecting bus sections and adds them all to get the check zone differential current.

The individual measuring elements can generate a trip command only if also the "check zone measuring element" detects an internal busbar fault. The check zone operation must be enabled by parameter setting.

- **Saturated waveform compensation:** in case of external fault, with the exception of the faulty bay, all bays deliver currents towards the busbar. The sum of these currents flows through the current transformer of the faulty bay. Consequently, this current can be extremely high, which can saturate the iron core of this current transformer. The shape of this secondary current gets distorted, and the "missing" section of the wave-shape is a differential current.

To prevent unwanted operation of the busbar differential protection function for these external faults, there are several remedies. One of them is the "saturated waveform compensation". The algorithm "keeps" the detected current peak till the end of the half period, decreasing the chance for the false trip decision.

- **Directionality check:** in case of internal fault, all bays deliver currents towards the busbar. In case of external fault however, with the exception of the faulty bay, all bays deliver currents towards the busbar, and the current of the faulty bay flows out of the busbar. When considering this basic difference, the stability of the busbar differential protection can be improved by "directionality check".

The busbar differential protection algorithm compares the sign of all current samples in a "measuring element". If during the majority of the samples one of the currents shows opposite sign, indicating opposite direction, then this fact prevents generation of the trip command.

- **Current transformer failure detection:** if the current transformers do not deliver correct currents for the evaluation then the correct decision of the busbar differential protection is not possible.

The currents are continuously supervised also during normal operation of the system, when the currents are below the operation level of the differential protection. If in this state any of the currents is missing then a relatively high differential current is measured which is still not sufficient to operate the differential protection. The algorithm performs the current supervision based on a similar characteristic as the trip characteristic, which has a sensitive base setting and a given slope.

If the measured currents result an Id–Is point above this characteristic, then after a time delay the "measuring element" gets blocked.

- **Checking the disconnector status signals:** the actual configuration of the busbar is evaluated using status signals of the disconnectors. The status of each disconnector is characterized by dual signals: "Disconnector open" and "Disconnector closed". Only one of them can be true and one of them can be false. This function checks these status signals, and performs the decision based on parameter setting.

In normal operation when receiving faulty status signals from the disconnectors the device keeps the previous state for a time period defined by parameter setting. After this time delay the reaction of the algorithm depends on the setting of the dedicated enumerated parameter. If the setting of the "BadState Tolerate" is true (On), then the operation neglects the faulty status signal, and the last valid status is kept. In case of setting "false" (Off), the "measuring element" gets blocked.

If the status error is detected after energizing or following parameter changes, the protection remains disabled until the faulty status is corrected, and generates "Differential protection disabled" and "Breaker failure disabled" status signals as well.

- **Dead zone:** At bus-coupler and bus-section bays, CT installed on one side of the circuit Breaker. In this application, the stage of the circuit breaker is considered: at its open state, the measured current must be eliminated to correctly clear the dead zone faults between the circuit breaker and the current transformer.

- **The breaker failure protection function:** The starting of the breaker failure protection is received on dedicated binary input channels. For operation, at least one of the phase currents of the bay must be above the level, as set an integer parameter value for each bay. Also, the time delay of the function and the duration of the pulse are parameter values.

- **Trip circuit supervision (74)**

The trip circuit supervision is utilized for checking the integrity of the circuit between the trip coil and the tripping output of the protection device.

This is realized by injecting a small DC current (around 1-5 mA) into the trip circuit. If the circuit is intact, the current flows, causing an active signal to the opto coupler input of the trip contact.

The state of the input is shown on the devices' binary input listing among the other binary inputs, and it can be handled like any other of them (it can be added to the user logic, etc.)

- **Lockout trip logic (86/94)**

The lockout version of the simplified trip logic function operates according to the functionality required by the IEC 61850 standard for the "Trip logic logical node". Its output can be set to lockout and be reset externally.

This simplified software module can be applied if only three-phase trip commands are required, that is, phase selectivity is not applied.

The function receives the trip requirements of the protective functions implemented in the device and combines the binary signals and parameters to the outputs of the device.

The operation can be normal or lockout. In normal mode, the output remains energized at least for a given pulse time and drops off as soon as the trip input drops off. The aim of this decision logic is to define a minimal impulse duration even if the protection functions detect a very shorttime fault.

In lockout mode the output stays active until the function gets a reset signal on its reset input.

The trip requirements and the reset signal are programmed by the user, using 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 command 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.

- **Definite time undervoltage protection (27)**

The definite time undervoltage protection function measures the RMS values of the fundamental Fourier component of three phase voltages. The Fourier calculation inputs are the sampled values of the three phase voltages (UL1, UL2, UL3), and the outputs are the basic Fourier components of the analyzed voltages (UL1Four, UL2Four, UL3Four). They are not part of the TUV27 function; they belong to the preparatory phase.

The function generates start signals for the phases individually. The general start signal is generated if the voltage is below the preset starting level parameter setting value and above the defined blocking level. The function generates a trip command only if the definite time delay has expired and the parameter selection requires a trip command as well.

The operation mode can be chosen by the type selection parameter. The function can be disabled, and can be set to “1 out of 3”, “2 out of 3”, and “All”.

The overvoltage 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.

- **Definite time overvoltage protection (59)**

The definite time overvoltage protection function measures three voltages. The measured values of the characteristic quantity are the RMS values of the basic Fourier components of the phase voltages. The Fourier calculation inputs are the sampled values of the three phase voltages (UL1, UL2, UL3), and the outputs are the basic Fourier components of the analyzed voltages (UL1Four, UL2Four, UL3Four). They are not part of the 59 function; they belong to the preparatory phase.

The function generates start signals for the phases individually. The general start signal is generated if the voltage in any of the three measured voltages is above the level defined by parameter setting value. The function generates a trip command only if the definite time delay has expired and the parameter selection requires a trip command as well.

The overvoltage 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.

MEASUREMENT FUNCTIONS

- **Measurement functions**

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

Measurement functions	OGYD	DGYD
Voltage (U1, U2, U3, U4, U12, U23, U31, Useq (U0, U1, U2)) and frequency	x	x

The measurement functions of the OGYD/DGYD configuration

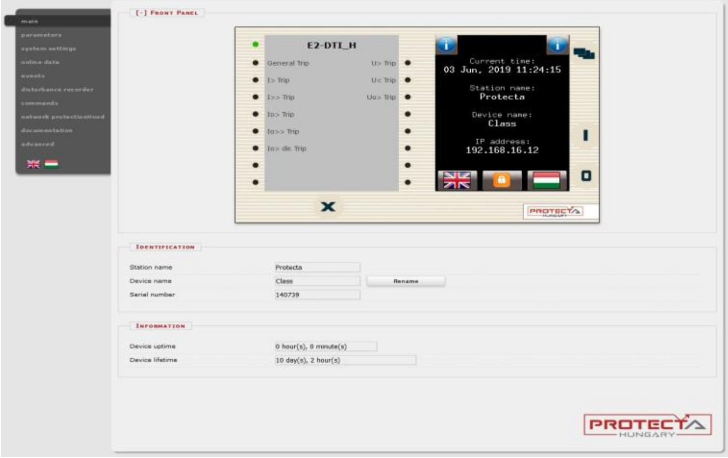
- **Monitoring functions**

For each bay the device measures and displays the phase currents (Amplitude and phase angle*).
* The reference vector selection depends on the configuration.

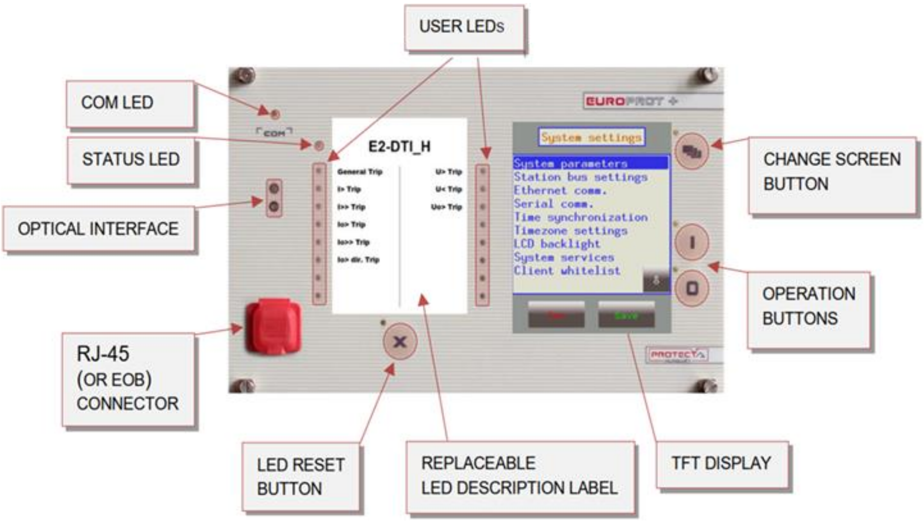
For each bus section the device measures and displays the differential currents (IDiff L1/L2/L3) and the bias currents (Ibias L1/L2/L3).

HMI AND COMMUNICATION TASKS

- **Embedded WEB-server:** Allows remote access via Ethernet port of device
  - Firmware upgrade possibility
  - Modification of user parameters
  - Events list and disturbance records
  - Password management
  - Online data measurement
  - Commands
  - Administrative tasks



- **Front panel TFT display handling:** the interactive menu set is available through the TFT and the touchscreen interface.
- **User keys:** capacitive touch keys on 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
    - Process bus (100Base-FX Ethernet)
    - EOB or EOB2 (Ethernet Over Board) or RJ-4 Ethern user interface on front panel
    - Optional 10/100Base-T port via RJ-45 connector
  - PRP/HSR seamless redundancy for Ethernet networking (100Base-FX Ethernet; 10/100Base-TX Ethernet)
  - Redundancy RJ-45 for Ethernet networking (10/100Base-TX 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
    - Proprietary process bus communication controller on COM+ module

FUNCTIONAL PARAMETERS

Busbar differential protection (87B)	
Operation	Off, On
Base Sensitivity	100-10000A in 1A steps
k Zone	40-90% in 1% steps
CheckZone Operation	Off, On
CheckZone Sensitivity	100-10000A in 1A steps
k CheckZone	40-90% in 1% steps
CT failure Sensitivity	50-5000A in 1A steps
k CT failure	60-90% in 1% steps
CT failure Delay	100-60000ms in 1ms steps
Max I load	100-10000A in 1A steps
Bad State Tolerance	Off, On
Bad State Delay	100-60000ms in 1ms steps
Breaker failure protection (50BF)	
Operation	Off, Current, Contact, Current/Contact
Retrip	Off, On
Start Ph Current	20-200% in 1% steps
Start Res Current	10-200% in 1% steps
Retrip Time Delay	15-1000ms in 1ms steps
Backup Time Delay	60-1000ms in 1ms steps
Pulse Duration	0-60000ms in 1ms steps
Lockout trip logic (86/94)	
Operation	Off, On, Lockout
Min pulse duration	50-60000ms in 1ms steps
Three-phase instantaneous overcurrent protection (50)	
Operation	Off, Peak value, Fundamental value
Start current	5-3000% in 1% steps
Residual instantaneous overcurrent protection (50N)	
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 time overcurrent protection (51N)	
Operation	Off, DefiniteTime, IEC Inv,IEC VeryInv, IEC ExtInv,IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI

Start current In = 1A or 5A In = 200mA or 1A Time Multiplier Minimum time delay for the inverse char. Definite time delay for definite type char. Reset time delay for the inverse char.	LongInv, ANSI LongVeryInv, ANSI LongExtInv 5-3000% in 1% steps 5-3000% in 1% steps 0.05-999 in 0.01 steps 40-60000ms in 1ms steps 40-60000ms in 1ms steps 60-60000ms in 1ms steps
Definite time undervoltage protection (27)	
Operation Start Voltage Block Voltage Reset Ratio Time Delay	Off, 1 out of 3, 2 out of 3, All 30-130% in 1% steps 0-20% in 1% steps 1-10% in 1% steps 50-60000ms in 1ms steps
Definite time overvoltage protection (59)	
Operation Start Voltage Reset Ratio Time Delay	Off, On 30-130% in 1% steps 1-10% in 1% steps 0-60000ms in 1ms steps
Disturbance recorder	
Operation Resolution Prefault PostFault Max Recording Time	Off, On 1/1.2 kHz; 2/2.4kHz 100-1000ms in 1ms steps 100-10000ms in 1ms steps 500-10000ms in 1ms steps

TECHNICAL DATA

HARDWARE	
Analog Inputs (Current & Voltage Input Modules)	
Rated current In	1A or 5A (selectable)
Rated voltage Vn	110V (± 10%)
Rated frequency	50Hz or 60Hz
Overload rating	
Current inputs	20A continuous, 175A for 10s, 500A for 1s, 1200A for 10ms
Voltage inputs	250V continuous, 275V for 1s
Burden	
Phase current inputs	0.01VA at In = 1A, 0.25VA at In = 5A
Voltage inputs	0.61VA at 200V, 0.2VA at 100V
Power Supply	
Rated auxiliary voltage	24/48/60VDC (Operative range: 19.2 - 72VDC) 110/220VDC (Operative range: 88 - 264VDC or 80-250VAC)
Power consumption	20W, 25W, 30W, 60W (Depend on type of power supply module)
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	0.2A at 220VDC, 0.3A at 110VDC (L/R=40ms) 2000VA max
Short time carrying capacity	35A for 1s
Operating time	Typically 10ms
Trip Contacts	
Rated voltage	24VDC/48VDC/110VDC/220VDC
Continuous carry	8A
Thermal withstand voltage	72VDC (Rated voltage: 24VDC or 48VDC) 150VDC (Rated voltage: 110VDC) 242VDC (Rated voltage: 220VDC)
Breaking capacity	4A (L/R=40ms)
Making capacity	30A for 0.5s
Operating time	With pre-trip 0.5 ms, without pre-trip typically 10 ms
Mechanical Design	

Installation Case Protection class	Flush mounting/Rack mounting 42 or 84 HP (height:3U) IP41 from front side, IP2x from rear side IP54 Rated mounting kit
Key & LED	
Device keys Capacitive touch key LEDS Number of configurable LED Device status LED	Capacitive touch keys 4 pcs yellow, 3 mm circular LEDs indicating touch key actions 16 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 100Base-FX	IP56 rated with RJ-45 connector MM/ST 1300 nm, 50/62.5/125 µm connector, (up to 2 km) fiber MM/LC 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), with max. 32 dB link attenuation SM/FC 1550 nm, 9/125 µm connector, (up to 50 km), with max. 27 dB link attenuation
Serial Interface	Plastic optical fiber (ASIF-POF) Glass with ST connector (ASIF-GS) Galvanic RS485/422 (ASIF-G)
PROTECTION & CONTROL FUNCTIONS	
Busbar differential protection (87B)	
Current measurement Current reset ration Operate time $I_{diff} \geq 2 \times I_n$ $I_{diff} \geq 5 \times I_n$ Operate time accuracy Reset time	Accuracy ± 2 % 0.7 Typical 20 ms < 15 ms < ± 20 ms 60 ms
Breaker failure protection (50BF)	
Pick-up starting accuracy Operating time accuracy Retrip time Reset ratio Current reset time	<2 % ±5% or ±15 ms, whichever is greater approx. 15 ms 0.9 16-25ms
Lockout trip logic (86/94)	
Pulse time	<3 ms
Three-phase instantaneous overcurrent protection (50)	
Using peak value calculation	

Operating characteristic Reset ratio Operate time at 2*Is Reset time Transient overreach	Instantaneous, accuracy < 6 % 0.85 <15 ms <40 ms 90%
Using Fourier basic harmonic calculation	
Operating characteristic Reset ratio Operate time at 2*Is Reset time Transient overreach	Instantaneous, accuracy < 2 % 0.85 <25 ms <60 ms 15%
Residual instantaneous overcurrent protection (50N)	
Using peak value calculation	
Operating characteristic (I>0.1 In) Reset ratio Operate time at 2*Is Reset time * Transient overreach	Instantaneous, accuracy <6% 0.85 < 15 ms < 35 ms 85 %
Using Fourier basic harmonic calculation	
Operating characteristic (I>0.1 In) Reset ratio Operate time at 2*Is Reset time * Transient overreach	Instantaneous, accuracy <6% 0.85 < 25 ms < 60 ms 15 %
Three-phase time overcurrent protection (51)	
Operating accuracy Operate time accuracy Reset ratio Reset time Dependent time char. Definite time char. Reset time accuracy Transient overreach Pickup time * Overshot time Dependent time char. Definite time char. Influence of time varying value of the input current (IEC 60255-151)	<2% (when 20 ≤ G_S ≤ 1000) ±5% or ±15 ms, whichever is greater 0.95 Dependent time char. Approx 60 ms < 2% or ±35 ms, whichever is greater < 2 % < 40 ms 30 ms 50 ms < 4 %
Residual time overcurrent protection (51N)	
Operating accuracy Operate time accuracy Reset ratio Reset time Dependent time char. Definite time char. Reset accuracy time	<3% (when 20 ≤ G_S ≤ 1000) ±5% or ±15 ms, whichever is greater 0.95 Dependent time char. Approx 60 ms < 2% or ±35 ms, whichever is greater

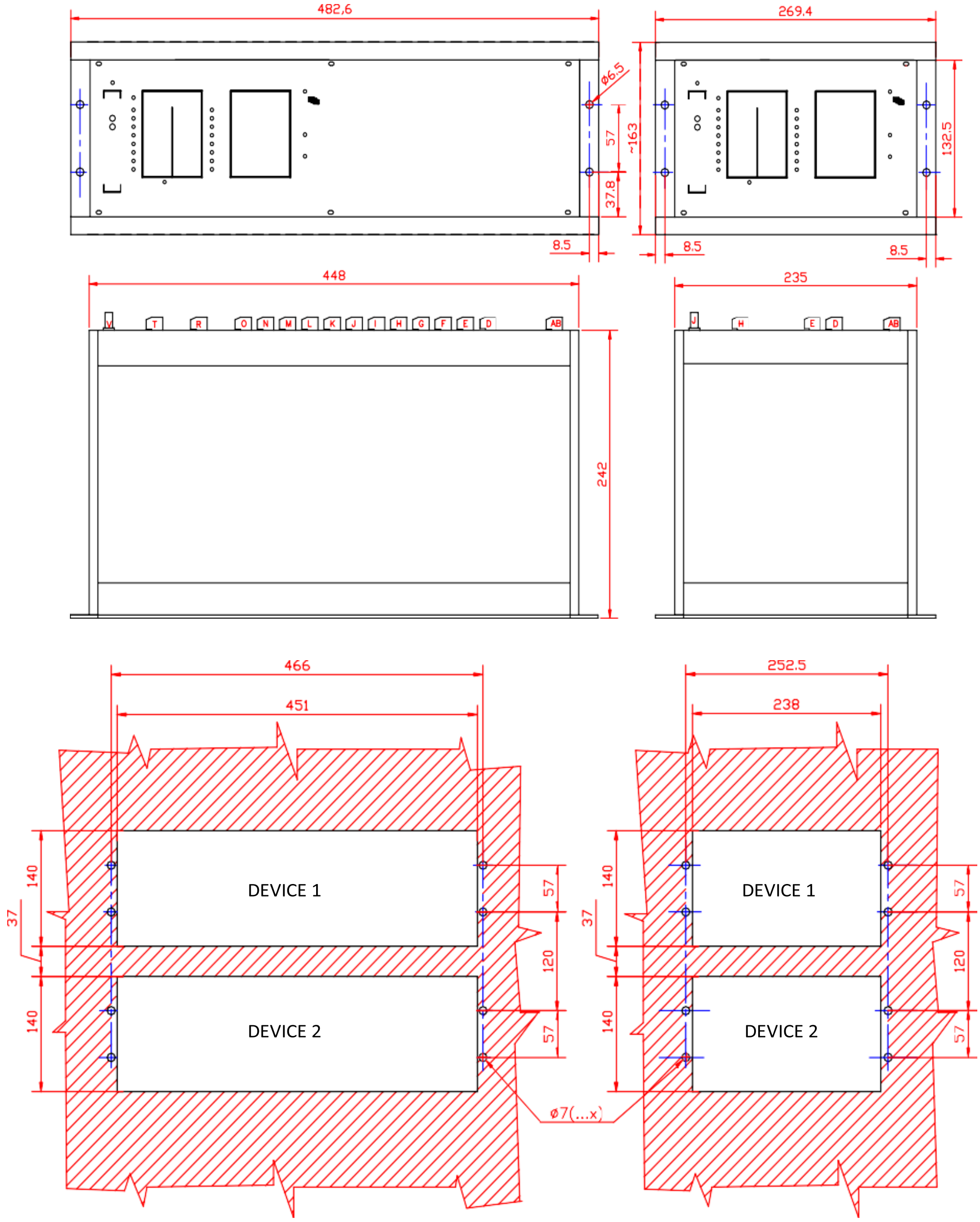
Transient overreach	< 2 %
Pickup time *	≤ 40 ms
Overshot time	
Dependent time char.	30 ms
Definite time char.	50 ms
Influence of time varying value of the input current (IEC 60255-151) accuracy	< 4 %
Definite time undervoltage protection (27)	
Pick-up starting accuracy	< ± 0,5 %
Reset time	
U> → Un	50 ms
U> → 0	40 ms
Operate time accuracy	< ± 20 ms
Minimum operate time	50 ms
Definite time overvoltage protection (59)	
Pick-up starting accuracy	< ± 0,5 %
Reset time	
U> → Un	60 ms
U> → 0	50 ms
Operate time accuracy	< ± 20 ms
Minimum operate time	50 ms
MEASUREMENT FUNCTION	
Voltage	
With VT+/2211	Range: 0.05 – 1.5 Un, accuracy: ±0.5%, ±1 digit
Frequency	Range: 40 – 60 Hz (50Hz system); accuracy: ±2mHz Range: 50 – 70 Hz (60Hz system); accuracy: ±2mHz

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 IEC 60068-2-30	Humidity: 10 % ... 93 %
Enclosure protection	IEC 60529	IP41 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

DIMENSION AND PANEL CUT-OUT

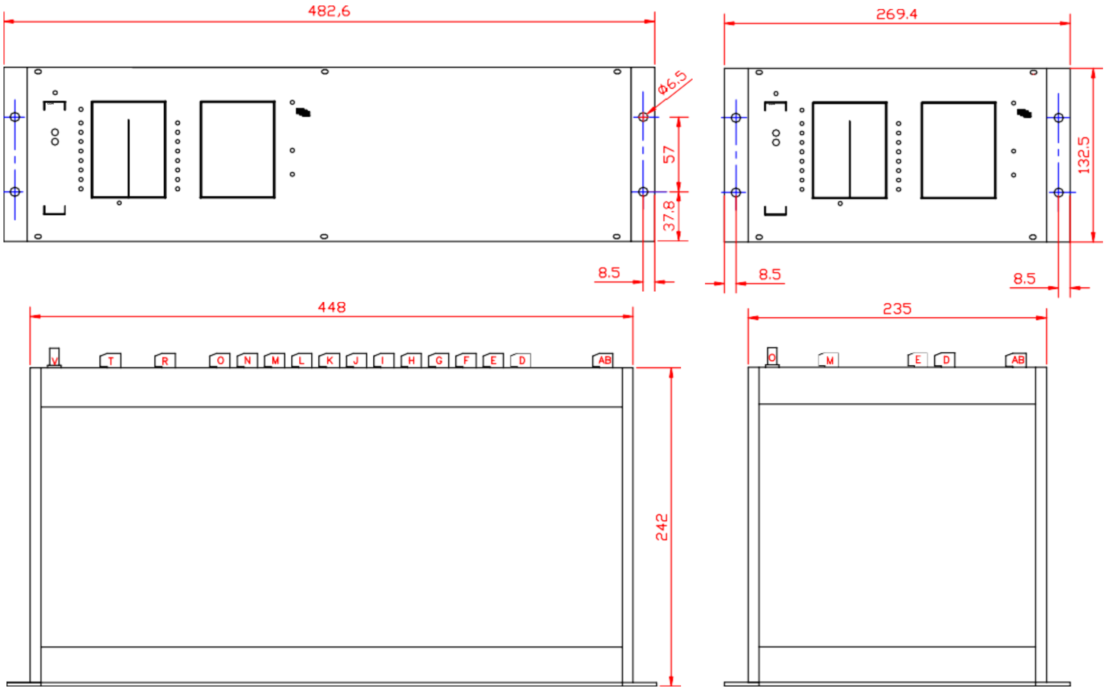
- **Flush mounting**



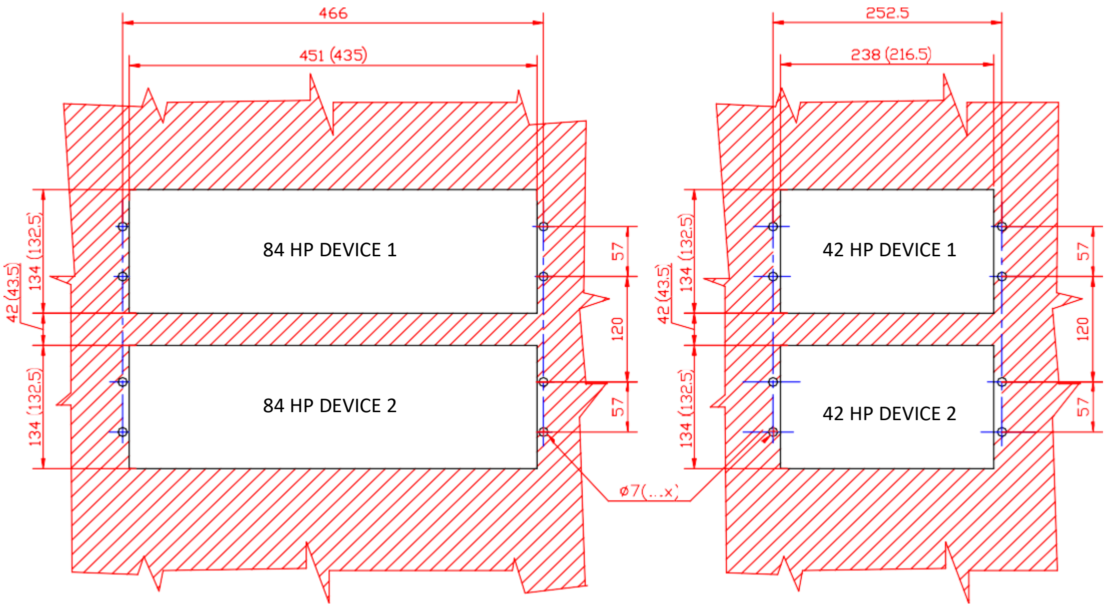
Dimension and panel cut-out for OGYD & DGYD devices (Flush mounting type)

- **Rack mounting**

When rack mounting is used the devices do not have a cover profile fit on. So it is possible to mount them in a 19" rack.



Dimension and panel cut-out for OGYD & DGYD devices (Rack mounting type)



Note that rack mounting type devices can also be mounted in a cut-out (e.g. on a switchgear door). It is possible to mount them from the front or from the back of the cut-out. The dimensions for rack mounting cut-outs are in the figure below. Dimensions in brackets are applicable in case of mounting from the back.

HARDWARE CONFIGURATION

- **I/O configuration**

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

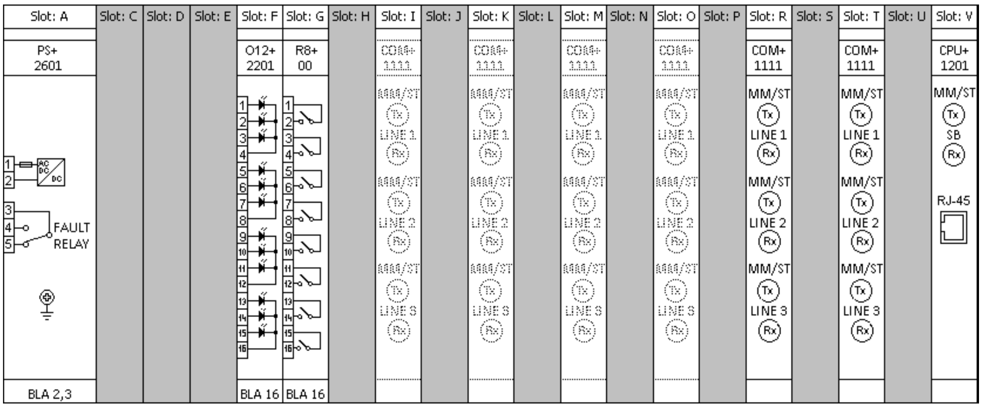
- **Decentralized type**

Hardware configuration	E1	E2	E3	E4	E5	E6	E7	E8	E10
Handled bay number (Max)	3	6	9	12	15	18	21	24	30
Voltage inputs	8(op.)	8(op.)	8(op.)	8(op.)	8(op.)	8(op.)	8(op.)	8(op.)	8(op.)
Binary inputs (Max)	120	108	96	84	72	60	48	36	24
Binary outputs (Max)	120	108	96	84	72	60	48	36	24

- **Centralized type**

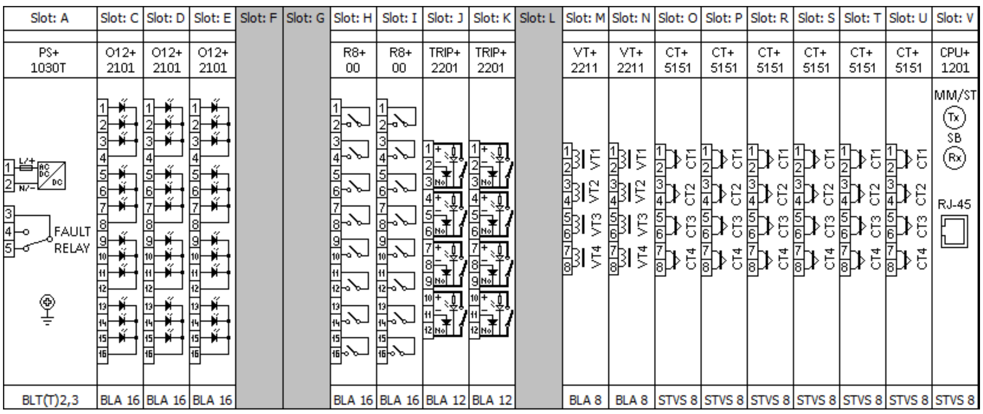
Hardware configuration	E33	E34	E35	E36	E38	E11	E14	E15	E16
Handled bay number (Max)	3	4	5	6	8	15	18	21	24
Voltage inputs	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.	Op.
Binary inputs (Max)	96	96	96	96	96	144	144	102	90
Binary outputs (Max)	53	53	53	53	53	113	105	88	80
Fast trip outputs (Max)	24	24	24	24	24	24	24	24	24

- **Module arrangement**
  - **OGYD**



Basic module arrangement of the decentralized (OGYD) type (Rear view)

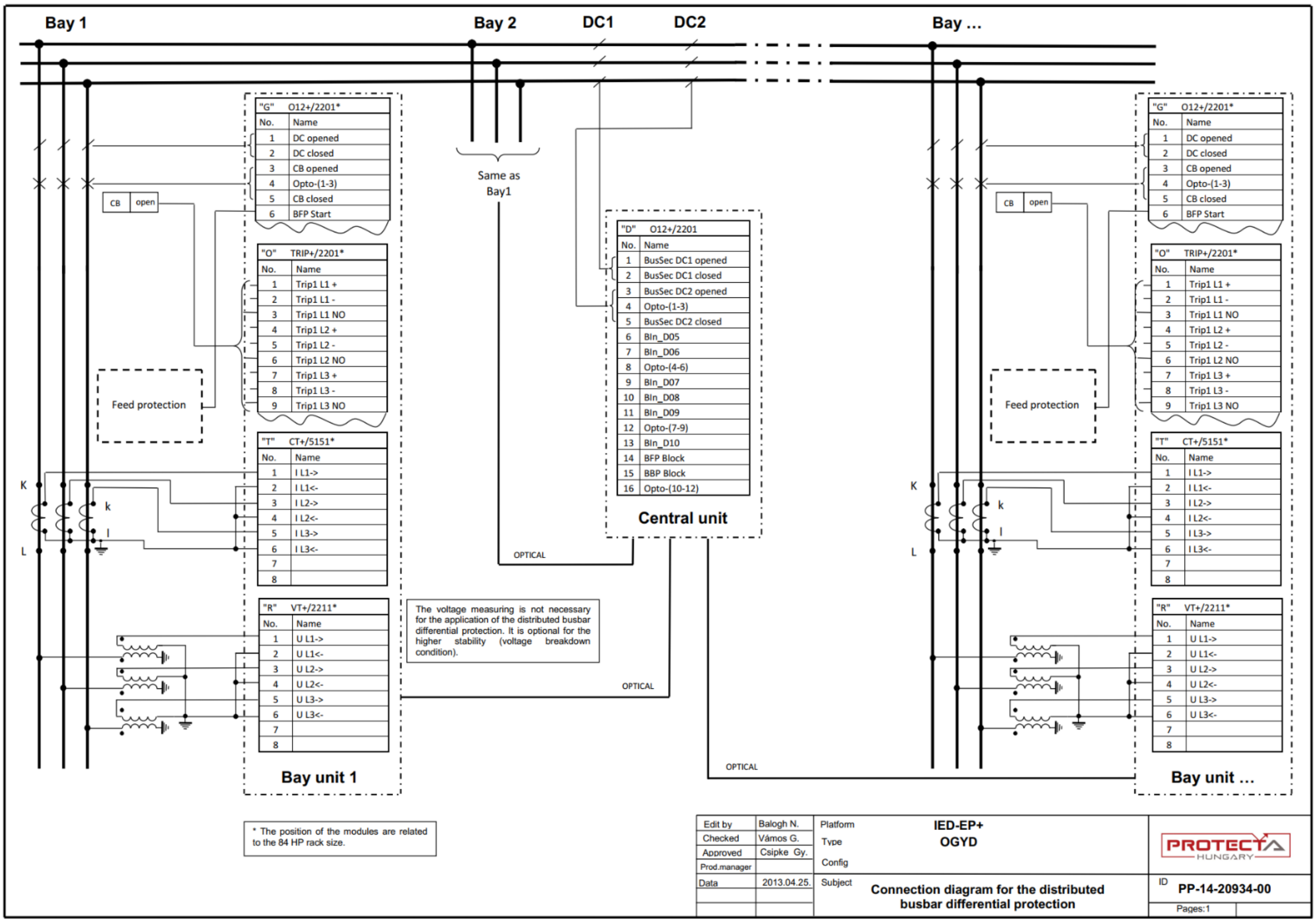
  - **DGYD**



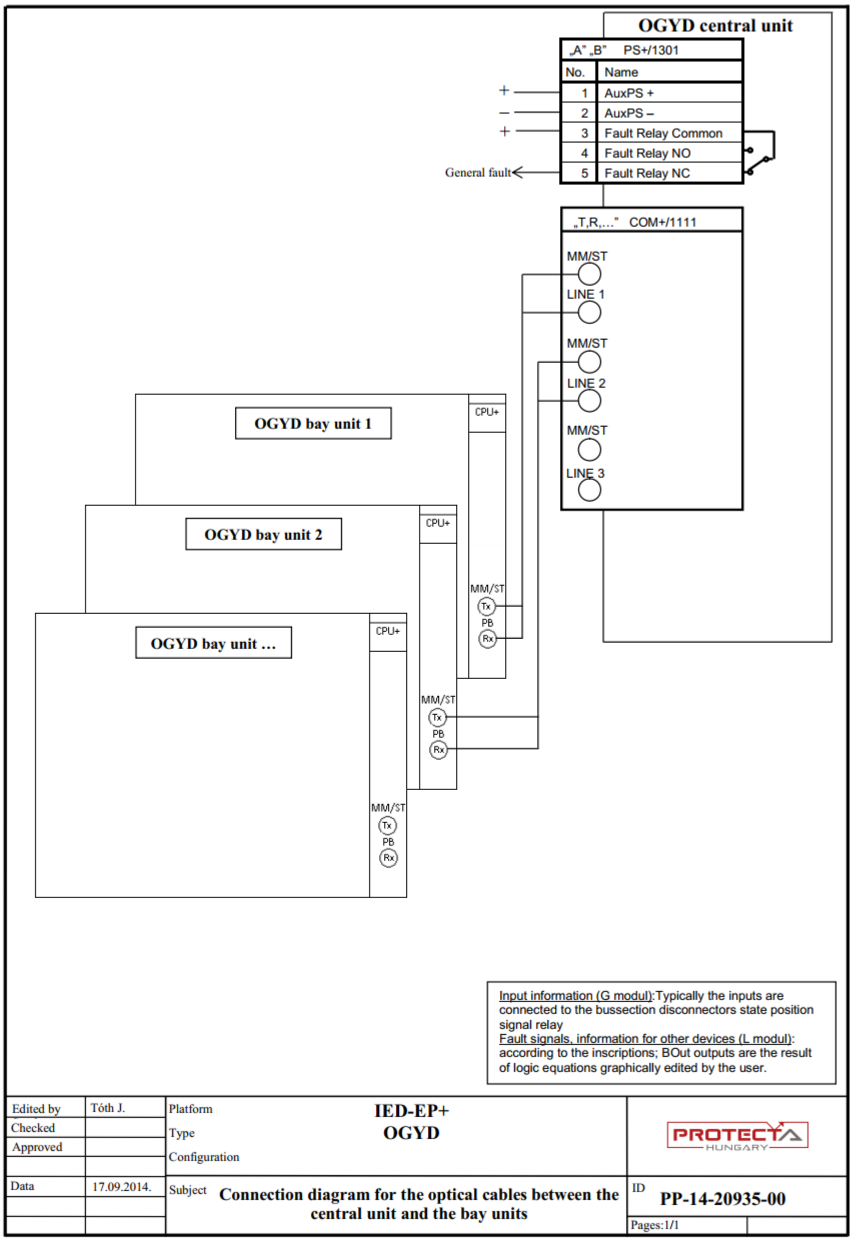
Basic module arrangement of the centralized (DGYD) type (Rear view)

EXTERNAL CONNECTION DIAGRAM

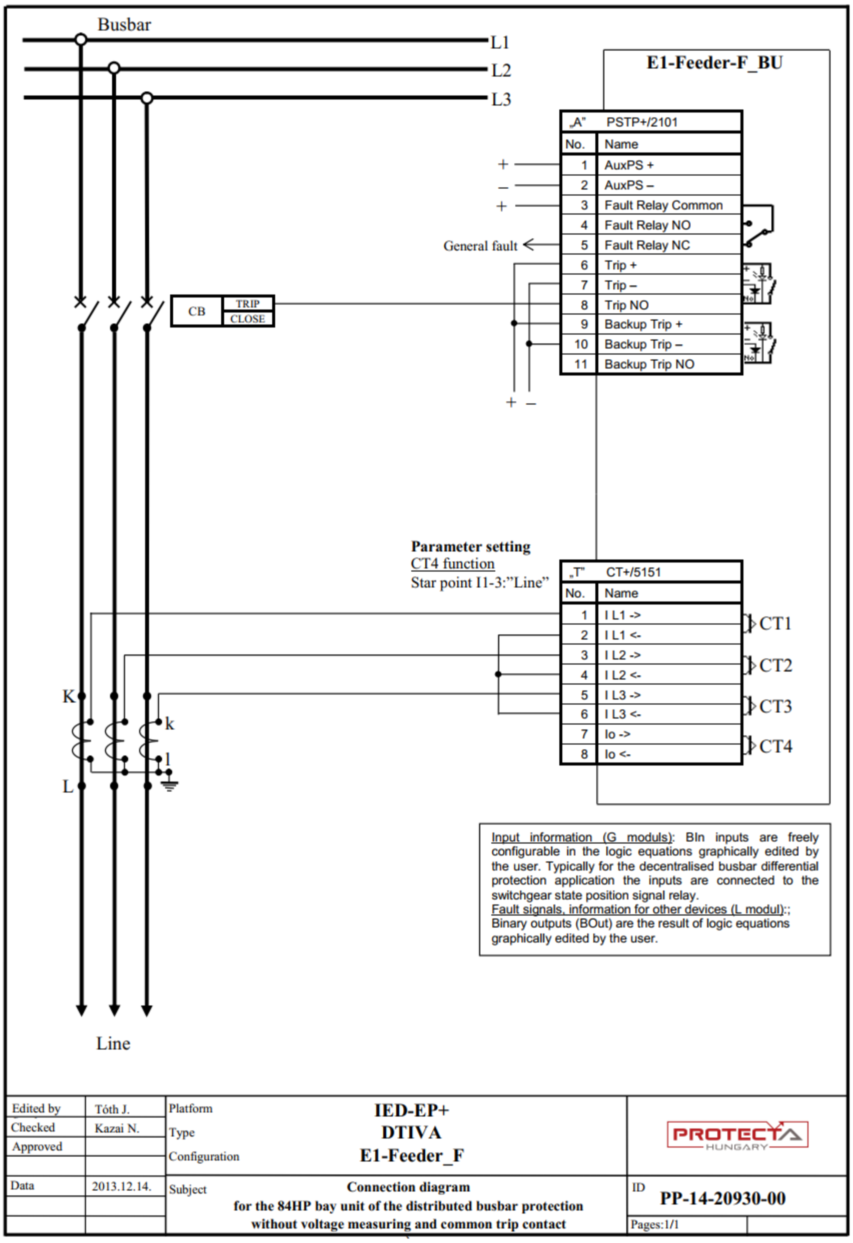
- **Distributed busbar differential protection OGYD**



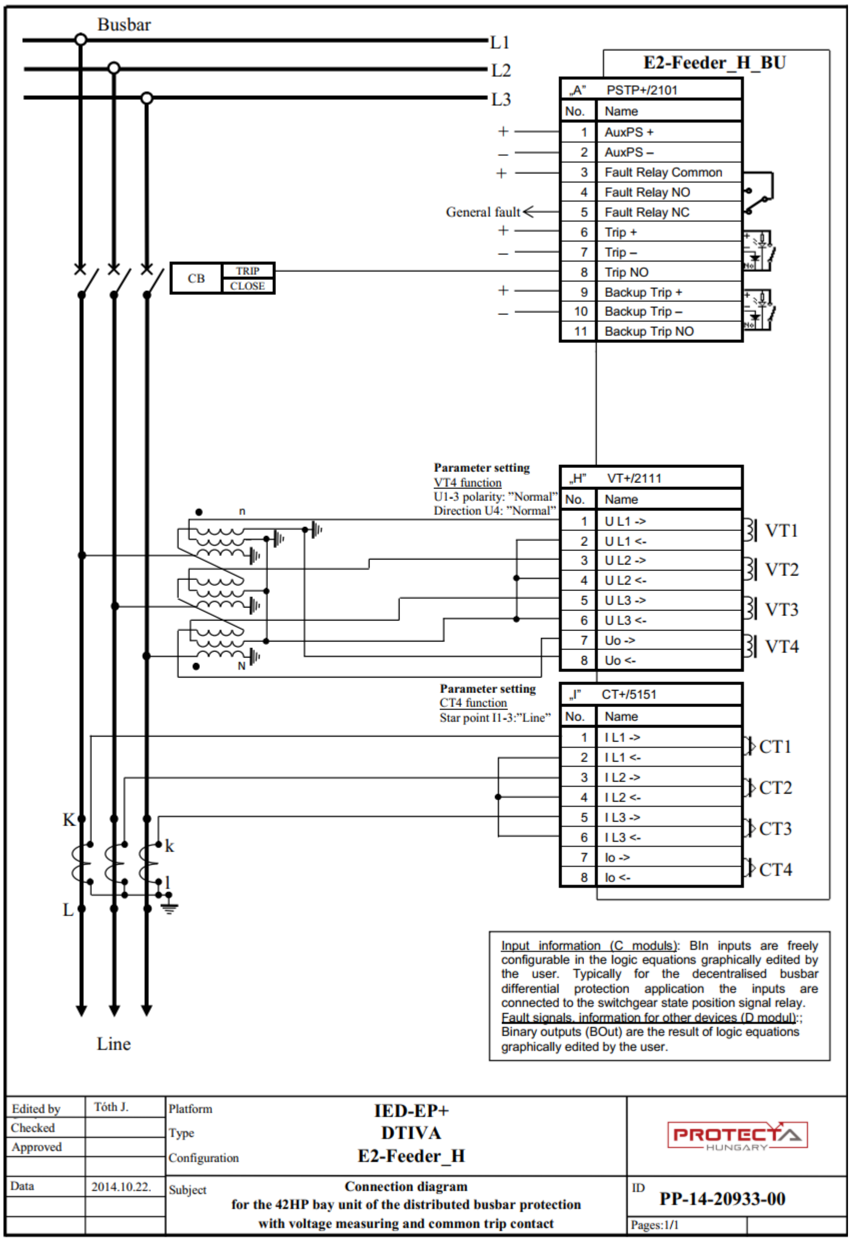
Typical connection diagram for the OGYD distributed busbar differential protection



Typical connection diagram for the optical cable between the central unit and the bay units (distributed busbar differential protection)

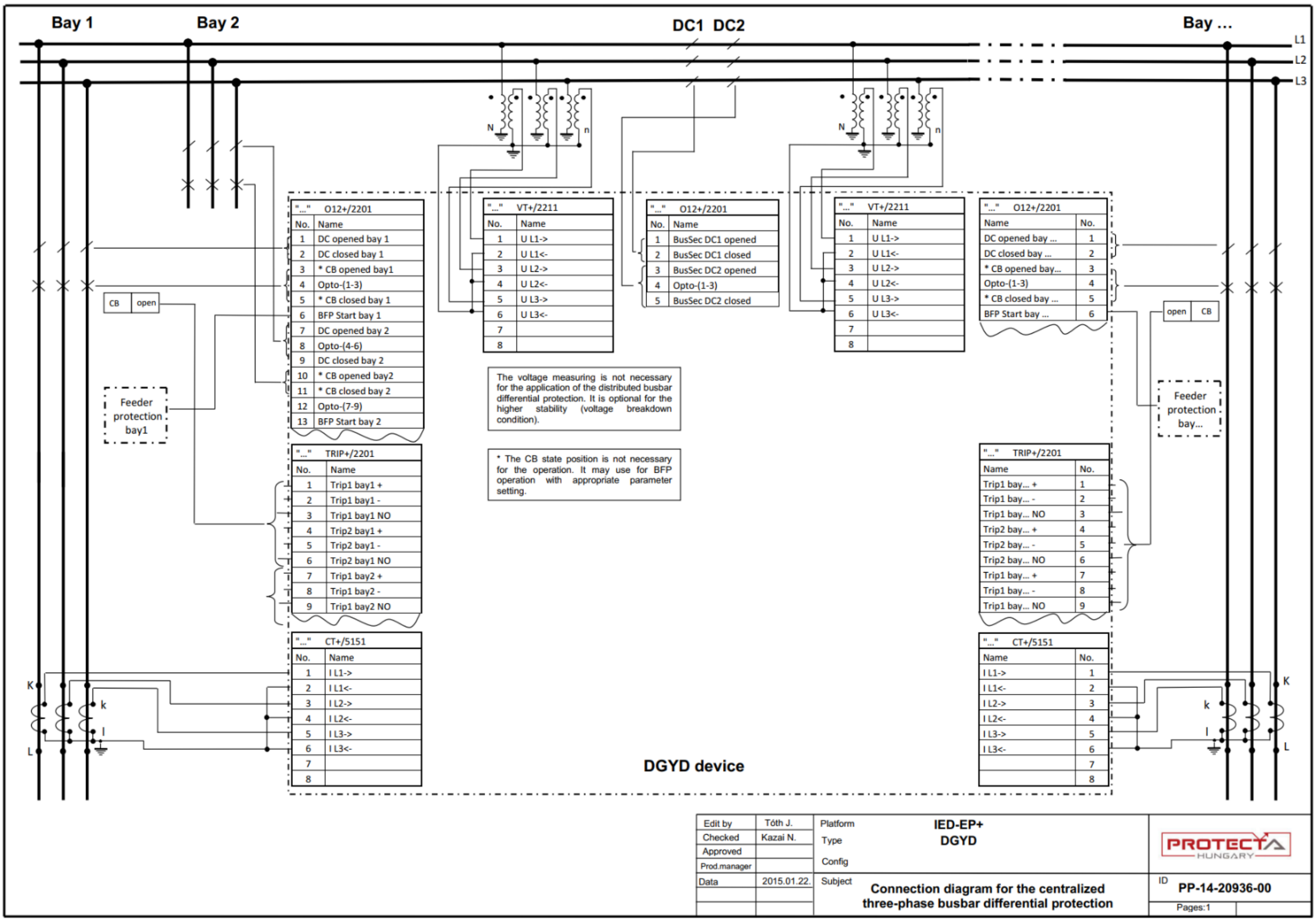


Typical connection diagram for the bay unit
(distributed busbar differential protection)



Typical connection diagram for the bay unit
(distributed busbar differential protection)

- **Centralized busbar differential protection DGYD**



Typical connection diagram for the centralized three-phase busbar differential protection

CONTACT

For more information, please refer to the **OGYD & DGYD** configuration description document or contact us:

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