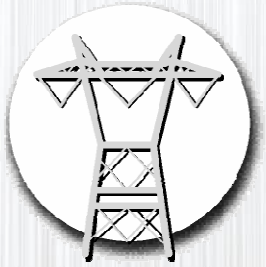
PROTECTIVE RELAYS

Selection guide to PROTECTA
Line Protections

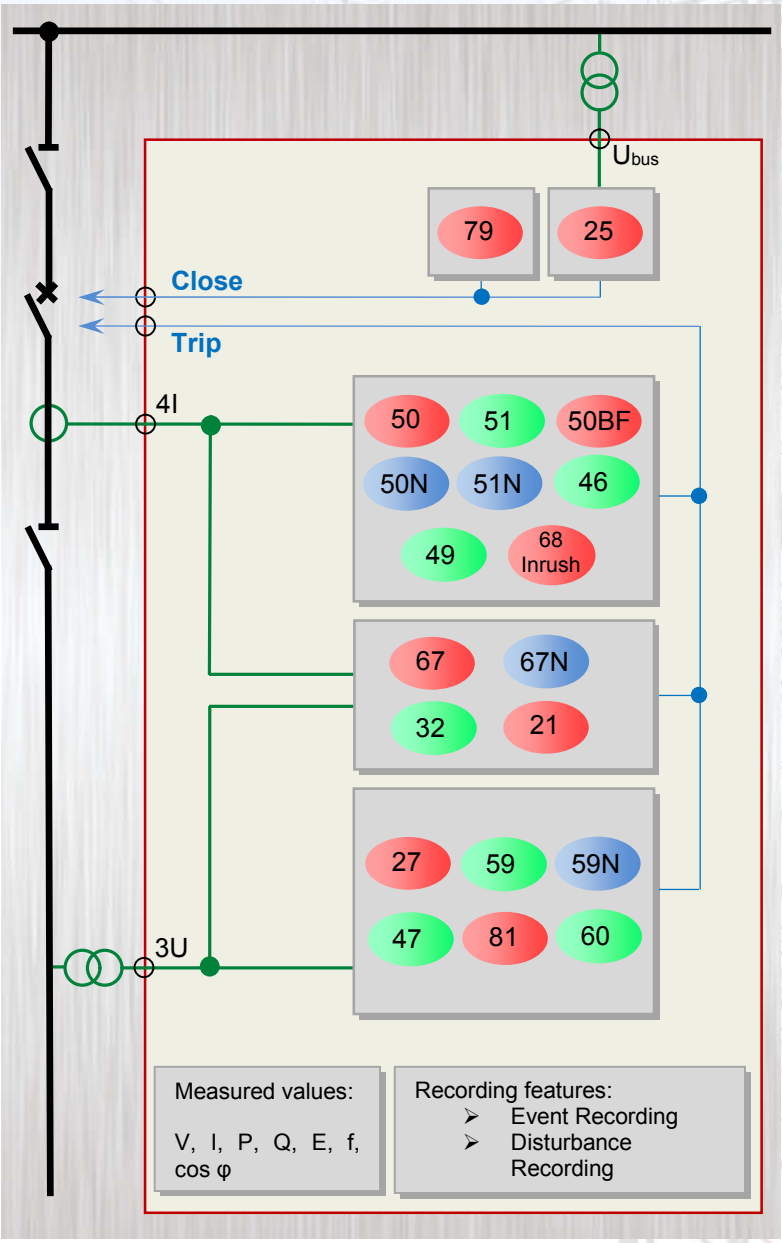


MICROENER

PROTECTA HUNGARY

1 DTIVA

The members of the DTIVA product line are configured to protect and control the elements of the medium voltage networks. These networks are usually not solidly grounded radial networks, the application of Petersen coils or grounding resistances result relatively low currents in case of single phase-to-ground faults. The majority of the protections are based on current measurements only, but application of distributed generation or loops in the network topology requires additional voltage measurement and directional protection functions.



1.1 Selection guide to DTIVA configurations

Version	Recommended application
/F-E1	Protection of overhead lines and cables on radial networks. The configured functions are based on current measurement, and they are extended with automatic reclosing function.
/D-E2	Protection of overhead lines and cables of compensated or resistance grounded networks. The configured functions are based on current and voltage measurement, and they are extended with automatic reclosing function. The voltage measurement is the basis of residual directional decision, power calculation and over- and undervoltage functions.
/Fr-E3	The configuration is designed to meet the requirements of a complex field unit for overhead lines and cables on compensated or resistance grounded networks. The range of functions include all current and voltage based applications, except distance protection and the line differential functions. The automatic reclosing function is performed with synchro-check. Frequency protection functions are included.
/L-E4	The configuration is designed to meet the requirements of a complex field unit for overhead lines and cables on compensated or resistance grounded networks. The range of functions include all current and voltage based applications, including distance protection function. The exception is the line differential function. The automatic reclosing function is performed with synchro-check. Frequency protection functions are included.
/Di-E5	The configuration is designed to meet the requirements of a complex field unit for overhead lines and cables on compensated or resistance grounded networks. The range of functions include all current and voltage based applications, except distance protection function and they are extended with automatic reclosing function. The configuration is extended with line differential protection function.
/Ld-E6	The configuration is designed to meet the requirements of a complex field unit for overhead lines and cables on compensated or resistance grounded networks. The range of functions include all current and voltage based applications, including distance protection function. The configuration is extended with line differential protection function, automatic reclosing function and frequency protection functions.
/M-E7	The configuration is designed to meet the requirements of a complex motor protection device for medium voltage motors.
/U-E8	The configuration is designed to measure voltages. Based on these measurement over- and undervoltage functions are realized. The configuration is extended with frequency protection functions.
/P-E9	The configuration is designed to be applied on networks with distributed generation. The unique function is the vector jump protection. Additionally to voltage-based functions also current base functions are added, and the measurements support the application of calculated power-based functions.
/C-E10	This simple configuration is designed to protect power capacitor units, based on current unbalance measurement.

All configurations include event logging and disturbance recorder, on-line measurements and various communication protocols.

1.2 Configurations

Version		F	D	Fr	L	Di	Ld	M	U	P	C
IEC	ANSI	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
I >>>	50	X	X	X	X	X	X	X			
I >, I >>	51	X	X	X	X	X	X	X		X	X
I Dir > >, I Dir >>	67			X	X		X				
Io >>>	50N	X	X	X	X	X	X	X			
Io >, Io >>	51N	X	X	X	X	X	X	X		X	X
Io Dir > >, Io Dir >>	67N		X	X	X		X	X			
$3I_dL$ >	87L					X	X				
Z <	21				X		X				
I_{2h} >	68	X	X	X	X	X	X	X			
I_2 >	46	X	X	X	X	X	X	X			
T >	49	X	X	X	X	X	X	X			
U >, U >>	59		X	X	X	X	X	X	X	X	Op.
U <, U <<	27		X	X	X	X	X	X	X	X	Op.
Uo >, Uo >>	59N		X	X	X	X	X	X	X	X	Op.
U_2 >	47		X	X	X		X	X			
U_1 <	27D							X			
f >, f >>	81O			X	X		X		X	X	
f <, f <<	81U			X	X		X		X	X	
df/dt	81R			X	X		X		X	X	
										X	
SYNC	25			X	X		X				
0 - > 1	79	X	X	X	X	X	X				
	60				X		X				
	60	X	X	X	X	X	X	X		X	X
CBFP	50BF	X	X	X	X	X	X	X		X	
$3I_dB$ >	48							X			
$3I_dB$ >	37							X			
	66							X			
P >	32		X	X	X		X			X	
P <	32		X	X	X		X			X	

1.3 Functions

- Three-phase instantaneous overcurrent protection (50)
- Three-phase time overcurrent protection (51)
- Three-phase directional overcurrent protection (67)
- Residual instantaneous overcurrent protection (50N)
- Residual time overcurrent protection (51N)
- Residual directional overcurrent protection (67N)
- Line differential (87L)
- Distance protection (21)
- Inrush detection and blocking (68)
- Negative sequence overcurrent protection (46)
- Thermal protection (49)
- Definite time overvoltage protection (59)
- Definite time undervoltage protection (27)
- Residual overvoltage protection (59N)
- Negative sequence overvoltage protection (47)
- Positive sequence undervoltage protection (27D)
- Overfrequency protection (81O)
- Underfrequency protection (81U)
- Rate of change of frequency protection (81R)
- Synchrocheck (25)
- Auto-reclose (79)
- Fuse failure (VTS) (60)
- Current unbalance protection (60)
- Breaker failure protection (50BF)
- Motor startup supervision (48)
- Undercurrent protection (37)
- Starts per hour (66)
- Directional overpower (32)
- Directional underpower (32)

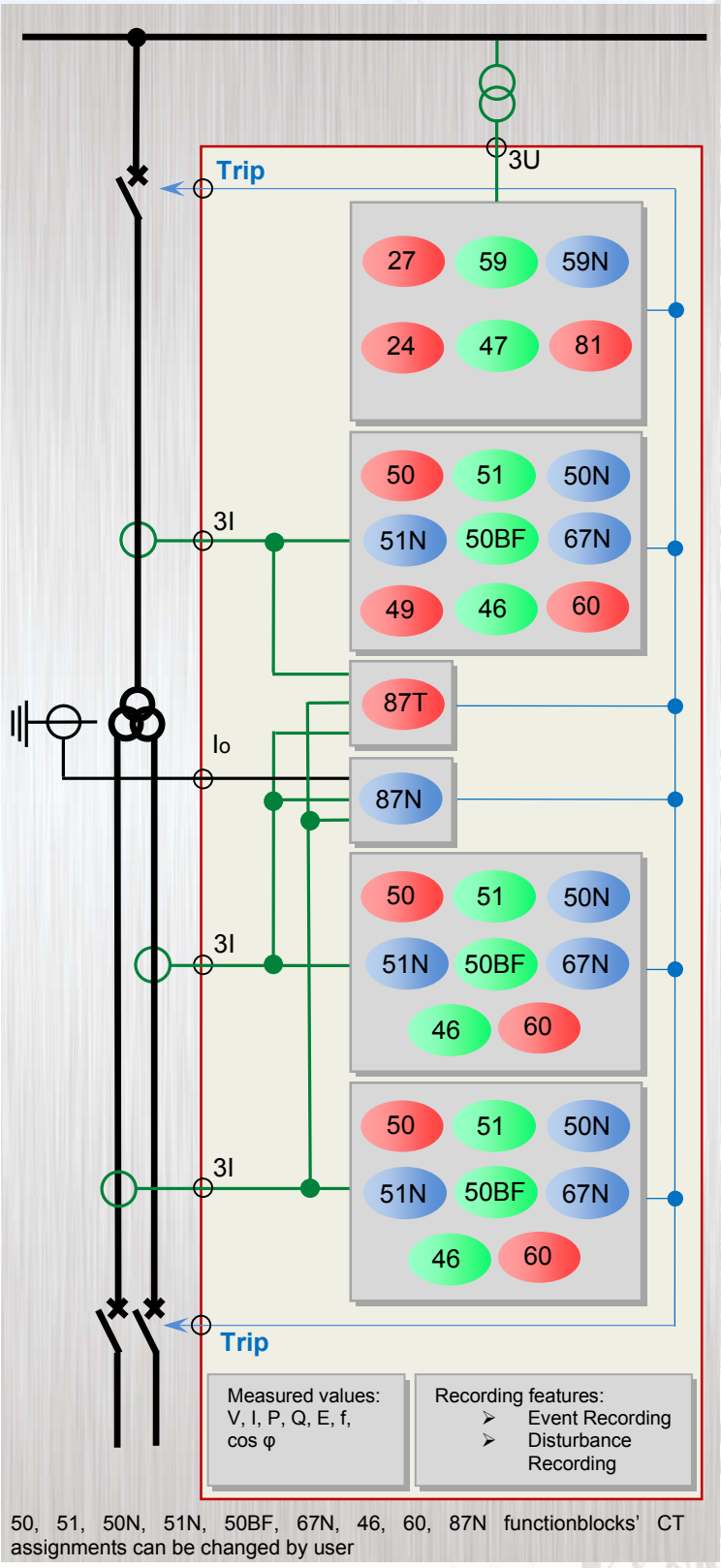
1.4 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)
- Circuit breaker wear
- Supervised trip contacts (TCS)

The full size rack

2 DTRV

The members of the DTRV product line are configured to protect and control high voltage/medium voltage transformers.



50, 51, 50N, 51N, 50BF, 67N, 46, 60, 87N functionblocks' CT assignments can be changed by user

2.1 Selection guide to DTRV configurations

Version	Recommended application
T2-E1	The DTRV E1 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. Also a thermal replica protection function is included.
T2V-E2	The DTRV E2 configuration measures three phase currents, the zero sequence current component from both sides of a two winding, three-phase transformer and additionally three phase voltages and the zero sequence voltage component. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the residual overcurrent function. The main protection functions are transformer differential protection and restricted earth-fault protection functions. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions. Also a thermal replica protection function is included.
T2R-E3	The DTRV E3 configuration measures three phase currents, the zero sequence current component from both sides of a two winding, three-phase transformer and additionally three phase voltages and the zero sequence voltage component. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the residual overcurrent function. The main protection functions are transformer differential protection and restricted earth-fault protection functions. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions. Also a thermal replica protection function is included. This configuration is extended also with tap-changer controller function.
T3-E4	The DTRV E4 configuration measures three phase currents and the zero sequence current component from all three sides of a three winding, three-phase transformer. The main protection functions are transformer differential protection and restricted earth-fault protection functions. Also a thermal replica protection function is included.
T3V-E5	The DTRV E5 configuration measures three phase currents, the zero sequence current component from all three sides of a three winding, three-phase transformer and additionally three phase voltages and the zero sequence voltage component. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the residual overcurrent function. The main protection functions are transformer differential protection and restricted earth-fault protection functions. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions. Also a thermal replica protection function is included.
T3R-E6	The DTRV E6 configuration measures three phase currents, the zero sequence current component from all three sides of a three winding, three-phase transformer and additionally three phase voltages and the zero sequence voltage component. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the residual overcurrent function. The main protection functions are transformer differential protection and restricted earth-fault protection functions. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions. Also a thermal replica protection function is included. This configuration is extended also with tap-changer controller function.
TR-E7	The DTRV E7 configuration is designed to perform the transformer tap-changer controller function. It measures three phase currents component and additionally three phase voltages component from both sides of the transformer. The tap-changer controller function considers also the voltage drop of serial network elements and the healthy state of the supplying high voltage network. Also the voltage limitation functions are included.
TZ-E8	The DTRV E8 configuration measures three phase currents and the zero sequence current component and additionally three phase voltages and the zero sequence voltage component. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the residual overcurrent function. The main protection function in this configuration is the impedance protection function with compounded circular characteristics.
TG-E9	The DTRV E9 configuration is designed to protect generators in the 2.5 MVA to 50 MVA power range. The device includes all generator protection function which are based on voltage and current measurement. Only the protection functions which need additional high voltage elements, like injectors, are excluded from the range of the functions.

All configurations include event logging and disturbance recorder, on-line measurements and various communication protocols.

2.2 Configurations

Version		T2	T2V	T2R	T3	T3V	T3R	TR	TZ	TG
IEC	ANSI	E1	E2	E3	E4	E5	E6	E7	E8	E9
I >>>	50	X	X	X	X	X	X			X
I >, I >>	51	X	X	X	X	X	X		X	X
Io >>>	50N	X	X	X	X	X	X			X
Io >, Io >>	51N	X	X	X	X	X	X		X	X
Io Dir > >, Io Dir >>	67N		X	X		X	X		X	
	87G									X
	21								X	
ΔZ/Δt	78									X
I_2 >	46	X	X	X	X	X	X	X	X	X
T >	49	X	X	X	X	X	X			X
$3I_dT$ >	87T	2w	2w	2w	3w	3w	3w			
REF	87N	X	X	X	X	X	X		X	
U >, U >>	59		X	X		X	X	X	X	X
U <, U <<	27		X	X		X	X	X	X	X
Uo >, Uo >>	59N		X	X		X	X		X	X
U_2 >	47		X	X		X	X			
f >, f >>	81O		X	X		X	X			X
f <, f <<	81U		X	X		X	X			X
df/dt	81R		X	X		X	X			X
V/Hz	24		X	X		X	X		X	X
	40									X
SYNC	25									X
	60									X
	60	X	X	X	X	X	X	X	X	X
CBFP	50BF	X	X	X	X	X	X			X
P >	32									X
P <	32									X

2.3 Functions

- Three-phase instantaneous overcurrent protection (50)
- Three-phase time overcurrent protection (51)
- Residual instantaneous overcurrent protection (50N)
- Residual time overcurrent protection (51N)
- Residual directional overcurrent protection (67N)
- Generator differential protection (87G)
- Impedance protection (21)
- Out-of-step (78)
- Negative sequence overcurrent protection (46)
- Thermal protection (49)
- Transformer differential (87T)
- Restricted earth fault (87N)
- Definite time overvoltage protection (59)
- Definite time undervoltage protection (27)
- Residual overvoltage protection (59N)
- Negative sequence overvoltage protection (47)
- Overfrequency protection (81O)
- Underfrequency protection (81U)
- Rate of change of frequency protection (81R)
- Overexcitation (24)
- Loss of excitation (40)
- Synchrocheck (25)
- Fuse failure (VTS) (60)
- Current unbalance protection (60)
- Breaker failure protection (50BF)
- Directional overpower (32)
- Directional underpower (32)

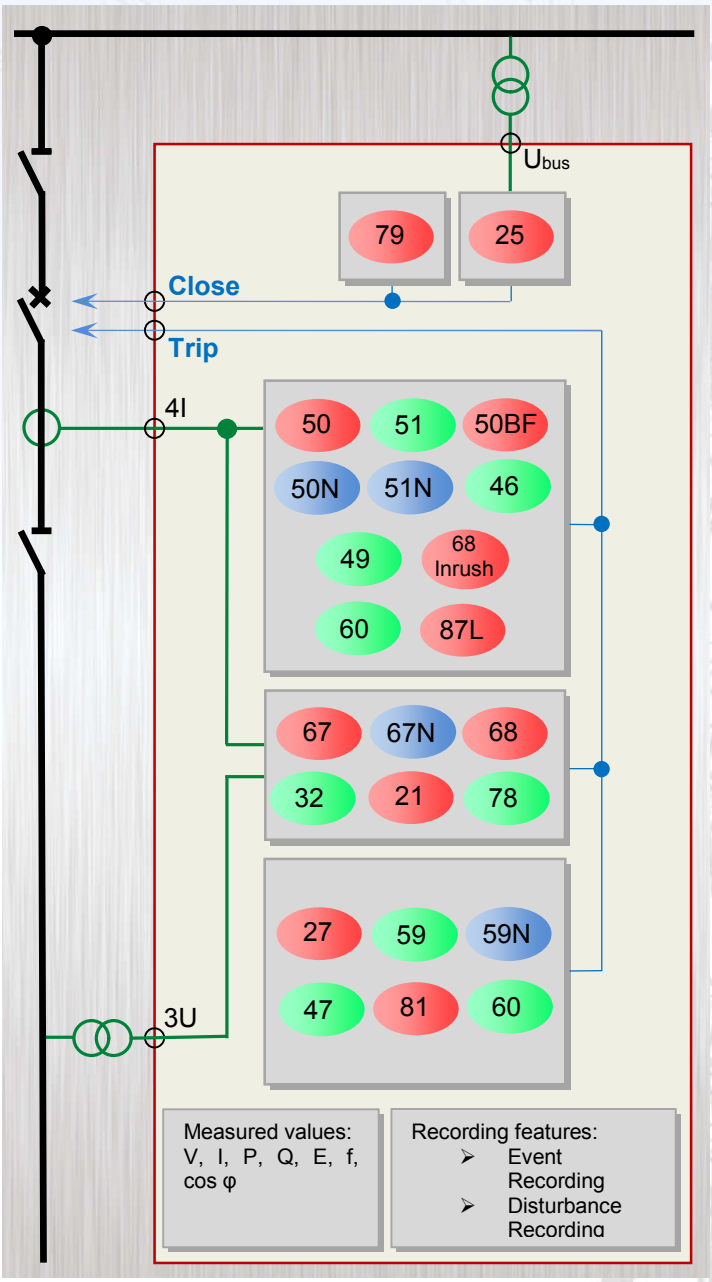
2.4 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)
- Supervised trip contacts (TCS)

The half size rack

3 DTVA

The members of the DTVA product line are configured to protect and control the elements of the high voltage networks. These networks are typically solidly grounded. In these networks the single phase-to-ground faults result high current, so these types of faults need fast protection functions similar to line-to-line faults.



3.1 Selection guide to DTVA configurations

Version	Recommended application
/L-E1	The DTVA E1 configuration measures three phase currents, the zero sequence current component of the parallel line and additionally three phase voltages and the busbar voltage. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the configured phase and residual overcurrent function and also directional overpower or underpower functions. The main protection function in this application is the distance protection function. The distance protection function can generate three-phase or single phase trip commands, depending on the fault types and the requirements. The choice of the functions is extended with the automatic reclosing function, synchro-check, power swing detection and switch-onto-fault logic. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions.
/Di-E2	The DTVA E2 configuration measures three phase currents, the zero sequence current component of the parallel line and additionally three phase voltages and the busbar voltage. These measurements allow, in addition to the current- and voltage-based functions, directionality extension of the configured phase overcurrent and residual overcurrent function and also directional overpower or underpower functions. There are two main protection functions in this application: they are the distance protection function and also the line differential protection function. The distance protection function can generate three-phase or single phase trip commands, depending on the fault types and the requirements. The communication hardware module sends and receives phase current vectors to realize the line differential protection function. The choice of the functions is extended with the automatic reclosing function, synchro-check and switch-onto-fault logic. Based on the voltage measurement also the frequency is evaluated to realize frequency-based protection functions.

All configurations include event logging and disturbance recorder, on-line measurements and various communication protocols.

3.2 Configurations

Version		L	Di
IEC	ANSI	E1	E2
I >>>	50	X	X
I >, I >>	51	X	X
I Dir > >, I Dir >>	67	X	X
Io >>>	50N	X	X
Io >, Io >>	51N	X	X
Io Dir > >, Io Dir >>	67N	X	X
$3I_dL$ >	87L		X
Z <	21	X	X
ΔZ/Δt	78	X	X
		X	X
	68	X	X
I_{2h} >	68	X	X
I_2 >	46	X	X
T >	49	X	X
U >, U >>	59	X	X
U <, U <<	27	X	X
Uo >, Uo >>	59N	X	X
U_2 >	47	X	X
f >, f >>	81O	X	X
f <, f <<	81U	X	X
df/dt	81R	X	X
SYNC	25	X	X
0 - > 1	79	X	X
	60	X	X
	60	X	X
CBFP	50BF	X	X
P >	32	X	X
P <	32	X	X

The double half size rack

3.3 Functions

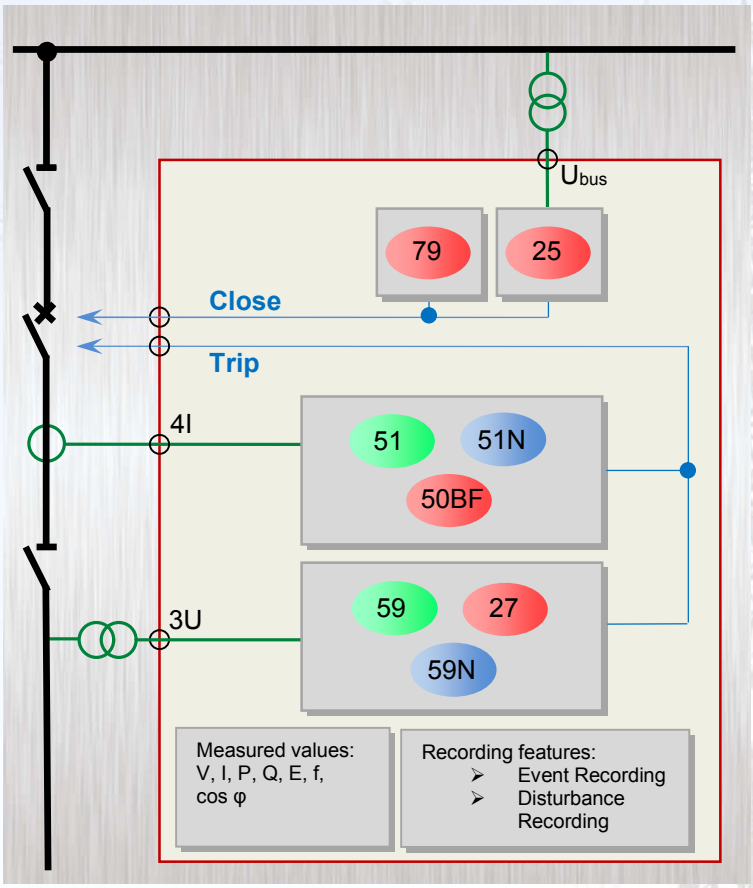
- Three-phase instantaneous overcurrent protection (50)
- Three-phase time overcurrent protection (51)
- Three-phase directional overcurrent protection (67)
- Residual instantaneous overcurrent protection (50N)
- Residual time overcurrent protection (51N)
- Residual directional overcurrent protection (67N)
- Line differential (87L)
- Distance protection (21)
- Out-of-step (78)
- Switch onto fault logic
- Power swing block (68)
- Inrush detection and blocking (68)
- Negative sequence overcurrent protection (46)
- Thermal protection (49)
- Definite time overvoltage protection (59)
- Definite time undervoltage protection (27)
- Residual overvoltage protection ((59N)
- Negative sequence overvoltage protection (47)
- Overfrequency protection (81O)
- Underfrequency protection (81U)
- Rate of change of frequency protection (81R)
- Synchrocheck (25)
- Auto-reclose (79)
- Fuse failure (VTS) (60)
- Current unbalance protection (60)
- Breaker failure protection (50BF)
- Directional overpower (32)
- Directional underpower (32)

3.4 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)
- Circuit breaker wear
- Supervised trip contacts (TCS)

4 DHMBR

The DHMBR configuration collects all functions related to the circuit breakers of the high voltage network.



4.1 DHMBR E1 configuration

Version	Recommended application
E1	The DHMBR E1 configuration measures three phase currents, the zero sequence current component and additionally three phase voltages and the busbar voltage. It can be applied if individual automatic reclosing function with synchro-check and circuit breaker failure protection function is to be applied with external starting signals. The simple voltage- and current-based protection functions are intended to support the main functions.

The configuration includes event logging and disturbance recorder, on-line measurements and various communication protocols.

4.2 Configuration

Version		E1
IEC	ANSI	
I >, I >>	51	X
Io >, Io >>	51N	X
U >, U >>	59	X
U <, U <<	27	X
Uo >, Uo >>	59N	X
SYNC	25	X
0 - > 1	79	X
	60	X
CBFP	50BF	X

4.3 Functions

- Three-phase time overcurrent protection (51)
- Residual time overcurrent protection (51N)
- Definite time overvoltage protection (59)
- Definite time undervoltage protection (27)
- Residual overvoltage protection (59N)
- Synchrocheck (25)
- Auto-reclose (79)
- Fuse failure (VTS) (60)
- Breaker failure protection (50BF)

4.4 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)
- Circuit breaker wear
- Supervised trip contacts (TCS)

5 DGYD

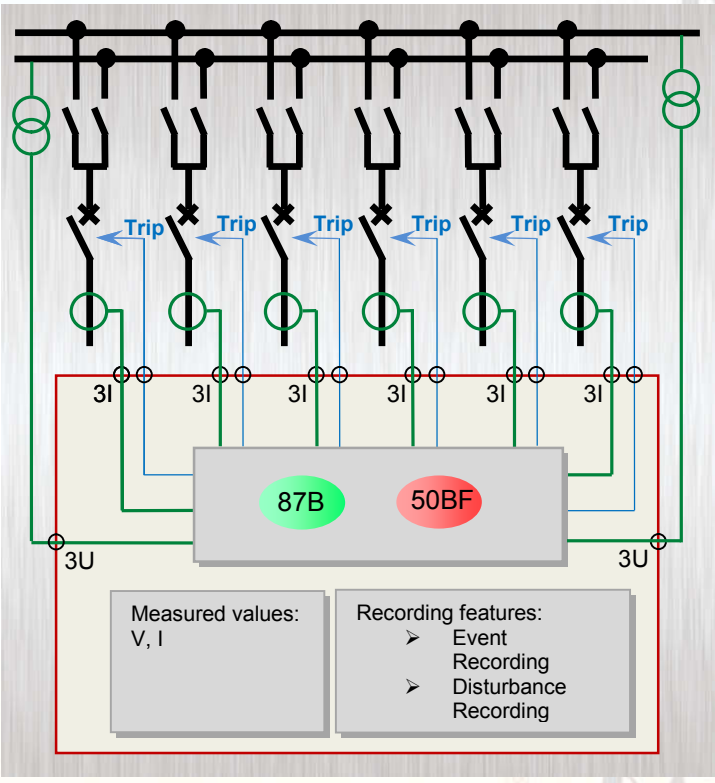
The centralized numerical busbar differential protection system has two configuration possibilities:

- It can be realized in one device, processing all three phase currents of all bays, or
- It can consist of three identical devices processing the phase currents separately for the phases.

The main features of the busbar differential protection function can be summarized as follows:

- The function is performed within one device, receiving analog currents and voltage and status signals from all bays of the busbar;
- 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 sectin are disconnected, all other bays remain in continuous operation;
- Easily to extend within the limitation of the hardware of three-phase or three single phase hardware versions;
- 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;
- The security and stability are increased with special software methods;
- Voltage breakdown condition,
- Check zone application,
- Saturated waveform compensation,
- Directionality check,
- Current transformer failure detection,
- Checking the disconnector status signals,
- Included breaker failure protection.

The individual configurations consist of different number of analog and binary input elements, determining the maximal extension of the bus structure to be protected.



5.1 Selection guide to DGYD configurations

Version	Recommended application
E11	In this version the configuration consists of three identical devices, processing the phase currents separately for the phases. To be applied for max. 12 bays, max 4 busbar sections.
E31	In this version the configuration measures three phase currents of 3 bays. To be applied for max. 3 bays, max 1 busbar section.
E32	In this version the configuration measures three phase currents of 4 bays. To be applied for max. 4 bays, max 1 busbar section.
E33	In this version the configuration measures three phase currents of 5 bays. To be applied for max. 5 bays, max 1 busbar section.
E34	In this version the configuration measures three phase currents of 6 bays. To be applied for max. 6 bays, max 1 busbar section.
E35	In this version the configuration measures three phase currents of 6 bays. To be applied for max. 6 bays, max 2 busbar sections.

All configurations include event logging and disturbance recorder, on-line measurements and various communication protocols.

5.2 Configurations

Version ▶		E11	E31	E32	E33	E34	E35
IEC	ANSI						
$3I_dT >$	87B	X	X	X	X	X	X
CBFP	50BF	X	X	X	X	X	X

5.3 Functions

- Busbar differential (87B)
- Breaker failure protection (50BF)

5.4 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Supervised trip contacts (TCS)

6 OGYD

Distributed numerical busbar differential protection:

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

Main features:

- The function is performed within one central device, but the analog currents and status signals from all bays of the busbar are accessed by protection devices dedicated to the bay;
- The bay units can perform any other protection function, but they communicate binary information with the central device via fiber optic links;
- 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 configuration;
- 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;
- The security and stability are increased with special software methods;
- Voltage breakdown condition,
- Check zone application,
- Saturated waveform compensation,
- Directionality check,
- Current transformer failure detection,
- Checking the disconnector status signals,
- Included breaker failure protection.

In the distributed version, the functionality of the busbar differential protection function is performed in co-operation of one central unit and of several bay units.

The central unit performs the organization of the busbar protection system, and also the numerical calculations and decisions are performed in this module. Based on the disconnector status information, received from the bay units, “Measuring elements” are composed. A “Measuring element” processes all currents, which flow into or out of the interconnected bus sections. The trip commands are passed to the circuit breakers via the protection device related to the bays. For the configuration, in the central device parameter values are needed; these parameter values are to be set in the central device for the bays individually.

The bay units are the “interface” between the power technology (measuring transformers, disconnector status signals, circuit breaker trip commands) and the busbar protection function in the central device. These units sample the assigned phase currents and voltages, and send them, together with the status information to the central device via fiber optic network.

6.1 Configuration

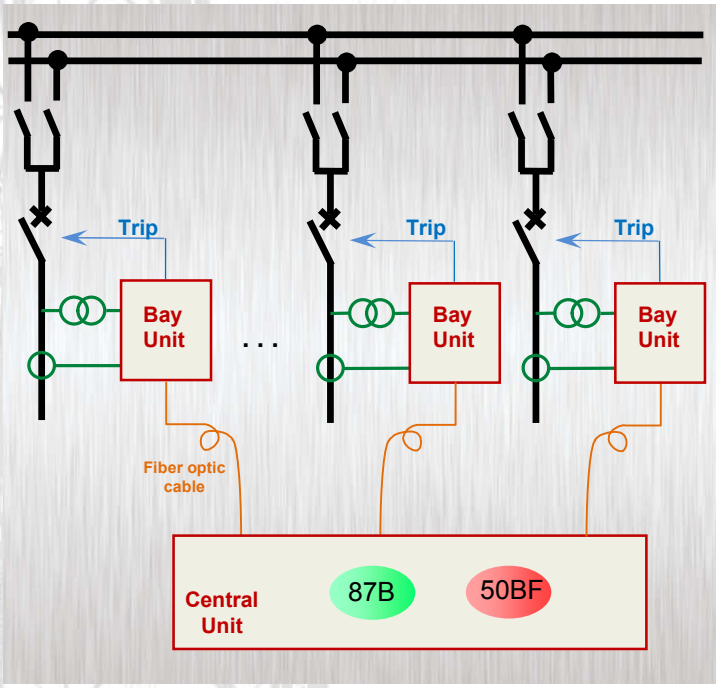
Version		OGYD
IEC	ANSI	
$3I_0T >$	87B	X
CBFP	50BF	X

6.2 Functions

- Busbar differential (87B)
- Breaker failure protection (50BF)

6.3 Measured values

- Current (I1, I2, I3, Io)
- Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency
- Supervised trip contacts (TCS)



MICROENER

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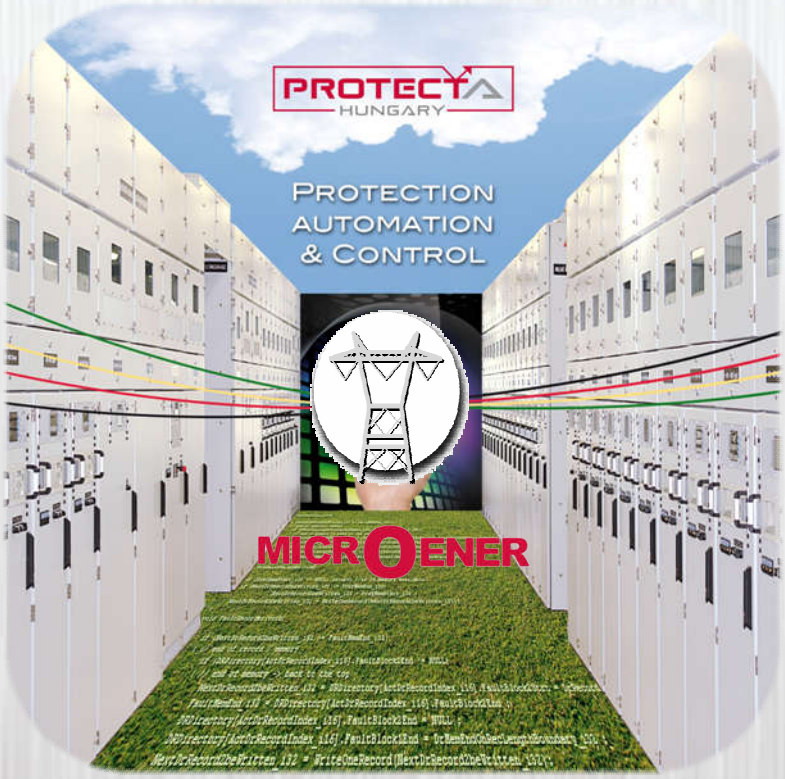
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