

E1-LINE

HIGH-VOLTAGE DISTANCE PROTECTION, CONTROL & AUTOMATION DEVICE



Overview

E1-Line is a dedicated transmission overhead line and cable protection, control and automation IED. The relay provides complex protection, control and monitoring functions. It is member of the DTVA product type in the EuroProt+ product family. The EuroProt+ family complex protection - in respect of hardware and software - is a modular device. Because of the modular architecture, the modules are assembled and configured according to the user's requirements; from that point on, the software determines the functions.

The **DTVA** product type is configured to protect, control and supervise the elements of the transmission network, where systems are typically solidly grounded throughout the world. In these networks single phase-to-ground faults result high current, similar to line-to-line faults; therefore, both types of fault need fast protection functions.

The relay can be used for single- or three-phase tripping and it supports double breaker terminals such as breaker and a half or ring bus topology.

The main protection functions of the **DTVA** type include high-speed distance protection with five independent protection zones and line differential protection. The relays support the general teleprotection schemes (POTT, PUTT etc.).

Additionally the DTVA product type includes a variety of versatile protection functions: directional and non-directional overcurrent protection, voltage-based protection and frequency-based protection.

The HV automatic reclosing function provides multi-shot autoreclosing with a synchro-check feature. The dead times can be set individually for each reclosing and separately for single-phase faults and multi-phase faults.

Because of the implemented control, measuring and monitoring function, the IED can also be used as a bay control unit.

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 .

GENERAL FEATURES

- Native IEC 61850 IED with Edition 2 compatibility
- Scalable hardware to adapt to different applications
- 84 HP or 42HP 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
- Advanced HMI functionality via color touchscreen and embedded WEB server, extended measuring, control and monitoring functions
- 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.
- Various protection 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.
 - 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: IEC61850; IEC60870-5-104; DNP3.0 TCP; Modbus TCP
 - Serial communication: DNP3.0; IEC60870-5-101/103; MODBUS, SPA
- The EuroProt+ family can handle several communication protocols simultaneously.
- Built-in self-monitoring to detect internal hardware or software errors
- Different time sources available: NTP server; Minute pulse; Legacy protocol master; IRIG-B000 or IRIG-B12X

Application

The E1-Line device is a dedicated transmission overhead line and cable distance protection and control IED; the relay offers complex protection, control and monitoring functions.

The E1-Line relay includes a variety of versatile protection functions such as directionality extension of the configured phase and residual overcurrent functions as well as directional over- or underpower functions.

Furthermore, the relay offers binary signal transmission or a teleprotection scheme with the remote-end IED via several types of communication channels.

The distance protection function can generate three-phase or single-phase trip commands, depending on the fault types and the requirements. The range of functions is supplemented with the automatic reclosing function, synchrocheck, power swing detection and switch-onto-fault logic. Based on the voltage measurement, the frequency is also evaluated to realize frequency-based protection functions.

The IED includes a wide range of control and supervisory functions, which provide full control and user-defined interlocking schemes for the primary switchgear at the substation.

The relay can be used as a back-up protection unit or as a decentralized busbar protection sub-unit.

SCOPE OF APPLICATION

- The main application is transmission overhead line and underground cable protection (including series-

compensated lines)

- Five independent distance protection zones with polygon-shaped or MHO characteristics
 - Load encroachment characteristics
 - The complex earth-fault compensation factor is applied for the correct impedance measurement of single-phase-to-earth faults
 - Non-directional impedance protection function or high-speed OC protection function for switch-onto-fault conditions
 - Power swing detection function can block the distance protection function in case of stable swings, or it can generate a trip command if the system operates out of step
 - Analogue input processing is applied to the zero sequence current of the parallel line
- 1-/3-phase tripping and support for double breaker terminals such as breaker and a half or ring bus topologies
- Binary signal transmission
- Numerous transfer tripping schemes available (PUTT, POTT, DUTT, Directional Compensation or Blocking, etc.)
- Current reversal and weak end infeed logic
- Autoreclosing up to four shots of reclosing; dead times can be set individually for each reclosing sequence and separately for single-phase faults and for multi-phase faults
- Full-scheme faulty phase identification by minimum impedance detection
- VT supervision and dead line detection
- Current unbalance detection of CT
- Switchgear automation and control with synchro-check/synchro-switch capability
- Programmable interlocking schemes
- Back-up protection for transformers, lines, generators, motors, busbars
- Optional decentralized busbar protection sub-unit application

Protection and control

The main protection function in this application is the distance protection function. It can generate three-phase or single-phase trip commands, depending on the fault types and the requirements. The list of functions is supplemented with the automatic reclosing function with synchro check/synchro switch feature, power swing detection and switch-onto-fault logic.

The E1-line configuration measures three phase currents, the zero sequence current component of the parallel line and, 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 functions and also directional overpower

or underpower functions.

Based on the voltage measurement, the frequency is also evaluated to facilitate frequency-based protection functions.

The implemented protection & control functions

Protection & control functions	IEC	ANSI	Inst.*
Three-phase instantaneous overcurrent protection function	I >>>	50	1
Three-phase time overcurrent protection function	I >, I >>	51	2
Directional three-phase time overcurrent protection function	I Dir > >, I Dir >>	67	2
Residual instantaneous overcurrent protection function	Io >>>	50N	1
Residual definite time overcurrent protection function	Io >, Io >>	51N	2
Directional residual delayed overcurrent protection function	Io Dir > >, Io Dir >>	67N	2
Distance protection function	Z <	21	1
		68	1
Inrush current detection function	I2h >	68	1
Negative sequence overcurrent protection function	I2 >	46	1
Line thermal protection function	T >	49	1
Definite time overvoltage protection function	U >, U >>	59	2
Definite time undervoltage protection function	U <, U <<	27	2
Residual definite time overvoltage protection function	Uo >, Uo >>	59N	2
Negative sequence definite time overvoltage protection function	U2 >	47	1
Overfrequency protection function	f >, f >>	81O	2
Underfrequency protection function	f <, f <<	81U	2
Rate of change of frequency protection function	df/dt	81R	1
Synchro check synchro switch function	SYNC	25	1
Switch onto fault preparation function			
	0 → 1	79	1
Voltage transformer and dead line detection supervision function		60	1
Current unbalance function		60	1
Breaker failure protection function for solidly grounded networks	CBFP	50BF	1
Directional overpower protection function	P >	32	2
Directional underpower protection function	P <	37	2

*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.

Function block diagram

