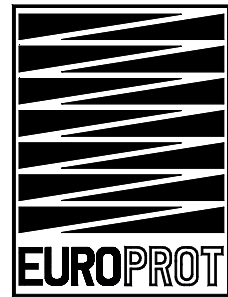


DCVA-EP

DCVA-DTVA-EP

DIGITAL PHASE SELECTIVE PROTECTION AND AUTOMATIC RECLOSER FOR RADIAL LINE END



The digital phase selective protection and automatic recloser for radial line end of type **DCVA-EP**, **DCVA-DTVA-EP** is part of device family named *EuroProt*. This short description contains special data of this type. General and common features of *EuroProt* family can be found in the *EuroProt* system information sheet. Accordingly it is proposed to study both this short description and system information sheet too, in order to understand the device entirely.



Application field

The **DCVA-EP** digital protection made by PROTECTA Co. Ltd. is designed for application on solidly grounded networks at consumer transformers, fed by radial line or at "T" connected line end.

The task of DCVA-EP protection is to disconnect the appropriate phase of the transformer circuit breaker at the radial or "T" connected line end, in case of single phase to ground fault. This should happen at the same time as or after the single phase interruption at the sending end of the line. Following the successful reclosing at the sending end it

recloses automatically the circuit breaker after the set dead time.

Concerning the dimensions, structure and connections of the device version DCVA-DTVA, it is identical with that of the DTVA-EP type digital distance protection. If the network is extended, and the concerned substation with radial topology is becoming part of the meshed network, the protection needs only software upgrading, and without further secondary changes in the bay, the device can be operated as distance protection.

Main features

The **DCVA-EP** type digital phase selective line protection and automatic recloser is member of the numeric device family of PROTECTA Co. Ltd., called *EuroProt* .

Overcurrent function:

- two zero sequence overcurrent stages ($I_{0>>}$, $I_{0>}$) with fix and definite time delay.

Overvoltage / undervoltage stage:

- three-phase function with phase selective operation.

Software characteristics:

- built-in self check functions,
- digital event recorder for 50 event, event sequence recording with 1 ms time resolution for max. 300 events,
- analog event recorder for short-circuit current and voltage data,
- intelligent digital function matrix.

Hardware characteristics:

- fully numerical type, with individual A/D converters, digital signal processors (DSP) and separate main processor (DCVA-DTVA-EP version),
- 8 opto-coupler inputs,
- 16 output contacts,
- type of output contacts (NC, NO) can be selected when ordering,

Communication:

- relay setting with 2x16 character LCD display, suitable also for text messages and for event log display,
- on-line screen of auxiliary PC for support of commissioning,
- auxiliary communication connection selectable for RS 232 or fibre optic cable,
- optional SCADA connection with IEC 870 protocol,
- parameters can be saved and saved parameters can be downloaded again,
- real-time clock with battery-fed RAM, (which can be synchronised via fibre-optic connection by auxiliary PC, by the SCADA system, or via opto-coupler digital input).

Principle of operation

The **DCVA-EP** device is a fully microprocessor based construction, the functions and their versions are realised basically on software.

The device contains more 87C196 type 16 bit micro-controller and a DSP performing digital signal processing. The program is stored in EPROM, the message text for the display is stored in EPROM as well. The parameter setting is loaded in EEPROM. Events are recorded in battery supplied RAM. The man-machine interface consists of a keyboard with six push-buttons, above it the two row, 2 x 16 character LCD display, seven LEDs and two SW pushbuttons.

With auxiliary PC and with the handling program a device can easier be operated

The analog current and voltage inputs are connected via inductive internal measuring transformers and low-pass filters to the multiplexer then to the A/D converter, where all current and voltage signals are sampled in every 0,5 ms. The sampled values of the 16 bit A/D converter are passed via high speed CAN bus to the digital signal processors (DSP), which perform arithmetic operation with high speed. The outputs of the DSP are the processed and evaluated measurements, as "started" signals of the relay functions, which are sent to the CPU. The timers and logic functions are performed here. The central processor communicates via parallel bus with the opto-coupler inputs and with the relay drivers.

The protection measures the 120 kV voltage and current of the transformer. The evaluated current is the zero sequence $3I_0$ current at the 120 kV side, the evaluated voltages are U_r , U_s , U_t at the 120 kV side.

As in case of single phase to ground fault on the line the transformer supplies zero sequence current, the starting element of the short-circuit protection function is the two stage zero sequence overcurrent protection, according to parameter setting. The low set overcurrent stage detects all kinds of single

phase to ground fault located on the whole length of the line, and because of selectivity reasons, it has a time delay to be set by parameters.

The high set overcurrent stage has to operate only in case of ground faults on the protected line. To over-bridge the switching transients, it has a short, fixed 100 ms time delay.

The selection of the faulty phase is made by undervoltage relays in each phase, set by parameters. The protection at the line end must operate only in case of single phase ground faults, for this reason the programming of the function assures, that it will not operate in case two or three phase voltage dips.

The protection based on the 120 kV side U_r , U_s and U_t voltages operates not only by undervoltage function, but based on other parameters as overvoltage protection as well., the measured values of which are necessary for automatic reclosing.

In case of single phase fault the protection selects the faulty phase, and issues a single phase trip command with or without time delay, then an automatic reclosing is initiated.

The time delay measurement for the dead time is started either if the voltage recovers to the healthy three phase value, or at the moment of the CB trip, according to the logic parameter set.

After the trip of the circuit breaker ("CB" closed status signals) two time counting is started at the same time (tEVA and tLVA timers). The protection recloses the circuit breaker if the voltage is healthy either after expiry of the tEVA counter or when tLVA timer is running, and the voltage is healthy in all the three phases. In this way the three phase healthy operation is recovered, and the protection resets without external interaction.

If during the tLVA timer runtime the three phase voltage does not recover, or if the fault occurs again, then automatic reclosing function stops, and a definitive single phase trip state remains until the interaction of the operator.

The software delivered with DCVA-120/EP digital phase selective line protection and automatic recloser allows reading on-line information characteristic to the momentary state of the protection, and request and displaying digital events, and setting of the function parameters.

On-line information:

- 120kV side I_o current in A and U_r , U_s , U_t phase voltages in kV, operation and drop off of functions, display of three phase healthy voltages.
- state of the signals received on opto-coupler inputs,
- counting of single phase trip commands, automatic reclosing, and definitive trip commands,
- service display to check and test the device.

The digital event recorder stores the following events:

<i>DCVA enabling,</i>	<i>U_t undervoltage,</i>	<i>definitive trip,</i>
<i>DCVA local enabling,</i>	<i>$I_o >>$ operated,</i>	<i>voltage dependent single</i>
<i>remote enabling,</i>	<i>$I_o >$ operated,</i>	<i>phase reclosing,</i>
<i>remote disabling,</i>	<i>R phase trip,</i>	<i>CB failure,</i>
<i>acknowledgement,</i>	<i>S phase trip,</i>	<i>self-check disturbance.</i>
<i>U_r undervoltage,</i>	<i>T phase trip,</i>	
<i>U_s undervoltage,</i>	<i>automatic reclosing,</i>	

Beside the digital events the protection stores events evaluated in graphical form, the signals of which are as follows: $I_o >>$ and $I_o >$ operation, U_r , U_s , U_t undervoltage, DCVA trip, automatic reclosing, definitive trip.

Technical data

Rated secondary current, I_n	1A or 5 A
Rated voltage (line), U_n	100V

Rated frequency	50 Hz
Overload capacity, voltage circuit, thermal, continuous	$2 \times U_{\text{phase}} = 2 \times U_n / \sqrt{3}$
current circuit, thermal, continuous 1 s	4xI _n 100xI _n (if I _n = 1 A) 50xI _n (if I _n = 5 A)
Dynamic current limit	100xI _n
Accuracy, voltage relays (above 50 % U _n)	±2 %
Accuracy, current relays (above 50 % I _n)	±2 %
Accuracy timers, with 10 ms steps with 1 s steps	±3 ms ±12 ms
Reset ratio, current relays	95 %
Number of output relays	12 print relays
Type of contacts (NO / NC):	<i>to be selected at ordering, factory setting 1 NC 11 NO</i>
Output contacts, electrical data: rated switching voltage continuous load current making current DC breaking capability at 220 V, at pure conductive load at load of L/R = 40 ms <i>option</i> at load of L/R = 40 ms	250 V 8 A 16 A 0,25 A 0,14 A 4 A
Auxiliary DC voltage (the same supply unit) voltage tolerance	220 V or 110 V 88...310 V
Permissible ambient temperature	0° ...50° C
Insulation test (IEC 255)	2 kV, 50 Hz 5 kV, 1,2/50 μs
Disturbance test (IEC 255)	2,5 kV, 1 MHz
Electrostatic discharge (ESD, IEC 801-2)	8 kV
Burst test (IEC 801-4)	2 kV
Setting ranges	
Low set overcurrent function, I _{o>} / I _n [AV]	10...1000 %, step: 10 %
High set overcurrent function, I _{o>>} / I _n [AV]	10...1000 %, step: 10 %
CT rated primary current, I _n [AV]	100...1250 A, step: 50 A
Phase selective undervoltage functions	10 – 100 %, step 1%
Overvoltage function	10 – 100 %, step 1%
VT Rated primary voltage	10 – 250 kV, step 1 kV
Time delay, I _{o>} overcurrent function, t I _{o>}	100...5000 ms, step: 100 ms
tEVA single phase short reclosing dead time	100...6000 ms, step: 100 ms
tLVA single phase waiting time	10...100 s, step: 1 s
Logic parameter: voltage dependent reclosing	1 = yes, 0 = no
Healthy-to-work failure signal timer t[fail]	2 s fix value
External communication type	RS 232 or fibre optic cable
Serial communication Baud rate	150...19200 Baud (2x steps)
Optical fibre cable operation mode	Radial or loop
Daily automatic self-check time	0...23 hours 59 minutes (step 1 min)
Automatic self-check block	setting 60 min

Design, size

An **EuroProt** device is always rack mounted, it has two design forms. One of the form is suitable to be mounted into standard 19" cabinet frame, this form is also suitable to be mounted directly

to a relay panel with flash mounted form. The other form is a relay panel mounted device with raised-hinged form. Its size depends on the chosen form.

Outline size of 19" cabinet frame mounted device:

Width	Height	Depth
483 mm	132,5 mm	201 mm

Outline of the panel mounted device with raised-hinged form:

Width	Height	Depth
490 mm	250 mm	250 mm

Weight: 8 kg.

Options

The device can be extended by optional units:

- digital disturbance recorder (see separate information sheet),
- SCADA connection (see *EuroProt* system information sheet),
- output relays with 4 A breaking capability.

Information required with order

- Protection type [DCVA-120/EP or DCVA-DTVA-EP],
- Protection case type [19" cabinet frame mounted device, or panel mounted device with flash mounted form, panel mounted device with raised-hinged form,
- Rated current [1 A, 5 A],
- Rated voltage [100 V, 200 V],
- Output relay contact type [NC or NO, if deviates from the *Technical Data*],
- Options if needed
- Needed trip circuit supervision. (DCVA-DTVA-EP version)

