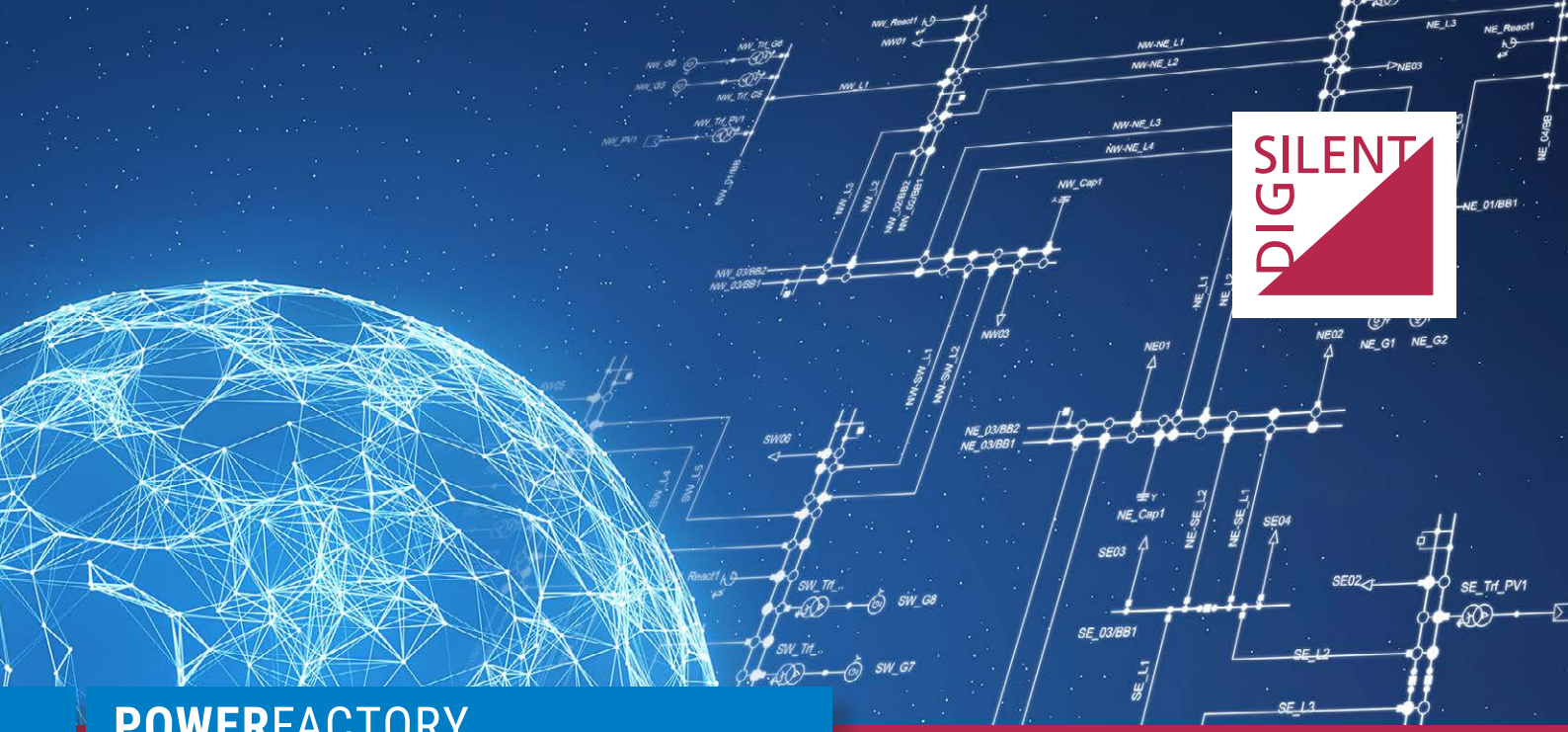

POWERFACTORY

PowerFactory 2021

Technical Reference

AEG PS 451

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

Publisher:
DIgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen / Germany
Tel.: +49 (0) 7072-9168-0
Fax: +49 (0) 7072-9168-88
info@digsilent.de

Please visit our homepage at:
https://www.digsilent.de

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Contents

1 Model information

Manufacturer AEG

Model PS 451

Variants This PowerFactory relay models cover most the features present in the different firmware versions of the AEG PS 451 relay .

2 General description

The microprocessor controlled, multifunctional overcurrent-time protection device AEG PS 451 is suitable for definite time or inverse-time overcurrent protection of h.v. motors, transformers, and power lines.
The PS 451 time-overcurrent protection device is a four-pole (A, B, C, N) measurement relay with phase-selective phase current timer stage with DTOC and IDMT characteristics, time-lag high set phase current timer stage, residual current timer stage with DTOC and IDMT characteristics, time-lag high set residual current timer stage, tripping matrix and circuit-breaker failure protection. In overload protection mode overload protection via thermal replica of the machine protects motors, transformers, and power lines against thermal overload.

The PowerFactory AEG PS 451 relay models are monolithic models and simulate most of the protective elements available in the relay. The following relay models are available:

- PS451-DT (to simulate the *DT Mode*)
- PS451-IDMT (to simulate the *IDMT Mode*)
- PS451-M (to simulate the *MP Mode*)

According to the selected *protection mode* one of the relay model version must be used.

The model implementation has been based on the information available in the relay technical brochures [2] [1].

3 Supported features

3.1 Measurement and acquisition

It represents the interface between the power system and the relay protective elements. The currents flowing in the power system are converted by a block which simulates the 3 phase CT and by a block which models a single phase CT detecting the earth current; the secondary currents are then measured in the relay model by two elements which simulate the digital sampling of the relay.

3.1.1 Available elements and input signals

The *Measurement and acquisition* feature consists of the following elements:

- One 3 phase current transformer (”Ct-3P” block).
- One single phase current transformer (”Ct-3I0” block).
- One 3 phase measurement element (”Measure Ph” block).
- One single phase measurement element (”Measure 3I0” block).

The following relay input signals are available to block the protective elements:

PS451-DT

- *Block I>* controlling *I>*
- *Block I>> 1* controlling *I>> 1*
- *Block I>> 2* controlling *I>> 2*
- *Block In>* controlling *Ie>*

PS451-IDMT

- *Block Ib* controlling *Ib*
- *Block I>> 1* controlling *I>> 1*
- *Block I>> 2* controlling *I>> 2*
- *Block In>* controlling *Ieb*

PS451-MP

- *Block Ib* controlling *Ib*
- *Block I>> 1* controlling *I>> 1*
- *Block I>> 2* controlling *I>> 2*
- *Block In>* controlling *Ie>*

3.1.2 Functionality

The ”Ct-3P” and the ”Ct-3I0” block represent ideal CTs. Using the CT default configuration the current at the primary side are converted to the secondary side using the CT ratio. The CT saturation and/or its magnetizing characteristic are not considered. Please set the ”Detailed Model” check box in the ”Detailed Data” tab page of the CT dialog and insert the data regarding the CT burden, the CT secondary resistance and the CT excitation parameter if more accurate simulation results are required.

The ”Measure Ph” and the ”Measure 3I0” block measure the currents sampling the input waves at 20 samples/cycles. The RMS values are calculated with a rectangular integration over a full cycle.

The input signals can be used to simulate the *reverse interlocking* feature.

3.1.3 Data input

The CT secondary rated current (1 or 5 A) value must be set in the ”Measure Ph” and in the ”Measure 3I0” block.

If no core CT is available please select the 3 phases CT also in the ”Ct-3I0” slot: the earth current will be calculated assuming that an Holmgreen’s connection of the phases is used.

3.2 Protective elements

A set of inverse time and definite time overcurrent elements is modeling the relay protective functions. All the inverse characteristics available in the relay are available in the inverse time model blocks. The breaker failure feature is also modeled.

3.2.1 Available Units

Overcurrent elements

PS451-DT

- Three 3-phase non-directional definite time overcurrent protection elements (”I>”, ”I>>1” and ”I>>2” block).
- Two residual definite time overcurrent protection elements (”Ie>” and ”Ie>>” block).

PS451-IDMT

- One 3-phase non-directional Inverse Definite Minimum Time (IDMT) characteristic overcurrent element(”Ib” block).
- Two 3-phase non-directional definite time overcurrent protection elements (”I>>1” and ”I>>2” block).
- One residual non-directional Inverse Definite Minimum Time (IDMT) characteristic overcurrent element(”Ieb” block).
- One residual non-directional definite time overcurrent protection element (”Ie>” and ”Ie>>” block).

PS451-M

- One 3-phase non-directional thermal image element(”Ib” block).
- Two 3-phase non-directional definite time overcurrent protection elements (”I>>1” and ”I>>2” block).
- Two residual non-directional definite time overcurrent protection elements (”Ie>” and ”Ie>>” block).

Breaker failure

- One timer element (”TimerCBF” block).
- One logic element (”Starting” block).

3.2.2 Functionality

Overcurrent elements The inverse time overcurrent elements (”I> IDMT” and ”In> IDMT” block) support the following trip characteristics:

- Extremly inverse.
- Long time inverse.
- Normally inverse.
- RI inverse.
- Very inverse.

The relationship between current and time values for the ”Normal Inverse”, ”Very Inverse”, ”Extremely Inverse” and ” Long Time Inverse” characteristic complies with the IEC 60255-3 and the BS 142 standards. The ”RI inverse” characteristic is a special characteristic used mainly in combination with existing mechanical relays.

Breaker failure The logic element (”Starting” block) is collecting the starting signals of the overcurrent elements. The input signals are combined by an OR logic and the resulting signal is sent to the timer element (”TimerCBF” block) together with the relay trip output signal. When both signals are *on* for a time longer than the time set in the timer element, a breaker failure condition is declared.

3.2.3 Data input

The relationships between the relay settings and the model parameters can be found in the following tables (the relay model parameter names are listed between brackets):

Overcurrent elements:
PS451-DT :

Address	Relay Setting	Model block	Model setting	Note
	I>	I>	Pickup Current (Ipset)	
	$t_{I>}$	I>	Time Setting (Tset)	
	I>> 1	I>> 1	Pickup Current (Ipset)	
	$t_{I>>1}$	I>> 1	Time Setting (Tset)	
	I>> 2	I>> 2	Pickup Current (Ipset)	
	$t_{I>>2}$	I>> 2	Time Setting (Tset)	
	IN>	Ie>	Pickup Current (Ipset)	
	$t_{IN>}$	Ie>	Time Setting (Tset)	
	IN>>	Ie>>	Pickup Current (Ipset)	
	$t_{IN>>}$:	Ie>>	Time Setting (Tset)	

PS451-IDMT :

Address	Relay Setting	Model block	Model setting	Note
	Setting I_B	Ib	Current Setting (Ipset)	
	Characteristic factor k_L	Ib	Time Dial (Tpset)	
	Phase current characteristic type	Ib	Characteristic (pcharac)	
	I>	I>	Pickup Current (Ipset)	
	$t_{I>}$	I>	Time Setting (Tset)	
	I>> 1	I>> 1	Pickup Current (Ipset)	
	$t_{I>>1}$	I>> 1	Time Setting (Tset)	
	I>> 2	I>> 2	Pickup Current (Ipset)	
	$t_{I>>2}$	I>> 2	Time Setting (Tset)	
	Setting I_{NB}	Ieb	Current Setting (Ipset)	
	Characteristic factor k_N	Ieb	Time Dial (Tpset)	
	Residual current characteristic type	Ieb	Characteristic (pcharac)	
	IN>>	Ie>>	Pickup Current (Ipset)	
	$t_{IN>>}$:	Ie>>	Time Setting (Tset)	

PS451-M :

Address	Relay Setting	Model block	Model setting	Note
	Setting I_B	Ib	Current Setting (Ipset)	
	Characteristic factor k_{1B}	Ib	Time Dial (Tpset)	
	Characteristic type	Ib	Characteristic (pcharac)	
	I>	I>	Pickup Current (Ipset)	
	$t_{I>}$	I>	Time Setting (Tset)	
	I>> 1	I>> 1	Pickup Current (Ipset)	
	$t_{I>>1}$	I>> 1	Time Setting (Tset)	
	I>> 2	I>> 2	Pickup Current (Ipset)	
	$t_{I>>2}$	I>> 2	Time Setting (Tset)	
	IN>	Ie>	Pickup Current (Ipset)	
	$t_{IN>}$	Ie>	Time Setting (Tset)	

Address	Relay Setting	Model block	Model setting	Note
	IN>> $t_{IN>>}$:	Ie>> Ie>>	Pickup Current (Ipset) Time Setting (Tset)	

Breaker failure :

Address	Relay Setting	Model block	Model setting	Note
	t_{CBF}	TimerCBF	Time Setting (Tdelay)	

3.3 Output logic

It represents the output stage of the relay; it's the interface between the relay and the power breaker.

3.3.1 Available elements and relay output signals

The following elements are part of the *Output logic* feature:

- one overcurrent elements trip element (”TripLogic” block).
- one breaker failure trip element (”CBFLogic” block).

The following relay output signals are available:

- ”Tripping”
- ”youtCBF”

3.3.2 Functionality

The ”TripLogic” block collects the trip signals coming from the overcurrent protective elements and operates the ”Tripping” relay output signal. The ”TripLogic” block output contact is ”yout”.

The ”CBFLogic” block gets the breaker failure logic trip commands and operates the ”youtCBF”relay output signal. The ”CBFLogic” block output contact is ”yout”.

Both ”TripLogic” and ”CBFLogic” operates the power breaker.

3.3.3 Data input

To disable the relay model ability to open the power circuit breaker simply disable the ”TripLogic” and the ”CBFLogic” block.

4 Features not supported

The following features are not supported:

4.1 All relay models

- User configurable *Tripping Matrix and Latch* (any overcurrent protective element trips the relay).
- *Measuring Circuit Monitoring*.

Please notice that time setting ranges with different step size e.g. tIN>> 0.01-9.99 s (step size = 0.01 s) and for tIN>> 10.0-99.9 s (step size = 0.1 s) are modeled with the full range and smallest step size -> tIN>> 0.01-99.9 s (step size = 0.01s)

4.2 PS451-M only

- Start-up frequency monitoring and reclosure blocking.
- Logic for heavy starting and protection with blocked rotor.
- Unbalance protection.
- Low load protection.

5 References

[1] AEG Starkstromanlagen Dresden GmbH, Bereich Schutz- und Schaltanlagenleittechnik System Protection and Control, Konigsbrucker Strasse 124,D - 01099 Dresden P.O. Box 10 03 60, D-01073 Dresden Germany. *Multifunctional Time-Overcurrent Protection Device AEG PS 451 SLTS.06.047911295 EN GrLp*.

[2] ALSTOM Energietechnik GmbH, Protection and Control Unit, Lyoner Straβe 44-48,D-60528 Frankfurt P.O. Box 710143, D-60491 Frankfurt Germany. *Multifunctional Time-Overcurrent Protection Device PS 451 AFSV.06.04792PDF0899EN M M*.