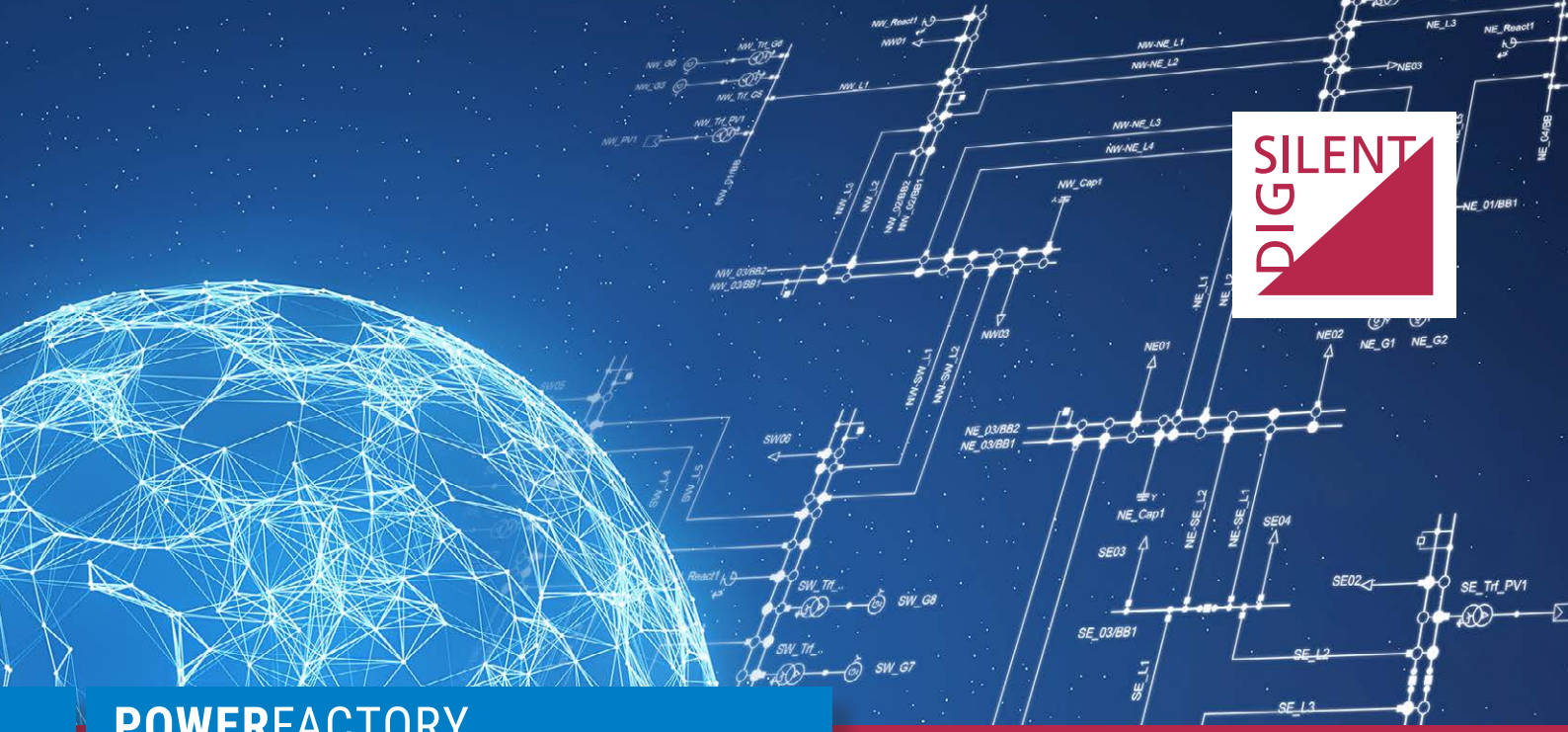

PowerFactory 2021

Technical Reference

AEG PS 441

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

November 15, 2019
PowerFactory 2021
Revision 924

Contents

1 Model information

Manufacturer AEG

Model PS 441

Variants This PowerFactory relay model covers the features present in the 301, 302, 401 and 603 firmware versions of the AEG PS 441 relay.

2 General description

The AEG PS 441 directional time-overcurrent protection devices are used for selective short-circuit protection in high-voltage networks. The networks can be operated with impedance neutral grounding, with resonant grounding or with an isolated neutral. The AEG PS 441 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, possibility of reverse interlocking,signal comparison through pilot wires and circuit-breaker failure protection.

The PowerFactory AEG PS 441 relay model is a monolithic model and simulate most of the protective elements available in the relay.

The model implementation has been based on the information available in the relay technical brochure and manual [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 Units

- 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).

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) values 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

- One 3 phase directional element (”Dir” block).
- One 3 phase directional overcurrent protection with Inverse Definite Minimum Time (IDMT) characteristic element(”I> IDMT” block).
- One 3 phase directional overcurrent protection with Definite Time(DTOC) characteristic element (”I> DTOC” block).
- One 3 phase directional overcurrent protection Time-lag (definite time) high set element (”I>>” block).
- One residual directional element (”Dir Ie” block).
- One residual directional overcurrent protection with Inverse Definite Minimum Time (IDMT) characteristic element(”In> IDMT” block).
- One residual directional overcurrent protection with Definite Time(DTOC) characteristic element (”In> DTOC” block).
- One residual directional overcurrent protection Time-lag (definite time) high set element (”In>>” 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 standards. The ”RI inverse” characteristic is a special characteristic used mainly in combination with existing mechanical relays.

Each inverse time and definite time overcurrent element can be set to trip for forward faults or for reverse faults or as non directional element.

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 :

Address	Relay Setting	Model block	Model setting	Note
1713	IDMT Base current I_B	I> IDMT	Current Setting (Ipset)	
1736	IDMT Characteristic factor	I> IDMT	Time Dial (Tpset)	
1735	IDMT Characteristic type	I> IDMT	Characteristic (pcharac)	
1714	IDMT Base current I_{NB}	In> IDMT	Current Setting (Ipset)	
1739	IDMT Characteristic factor	In> IDMT	Time Dial (Tpset)	
1738	IDMT Characteristic type	In> IDMT	Characteristic (pcharac)	
1700	DTOC Threshold operate value I>	I> DTOC	Pickup Current (Ipset)	
1704	DTOC Delay time $t_{I>}$:	I> DTOC	Time Setting (Tset)	
1701	DTOC Threshold operate value I>>	I>> DTOC	Pickup Current (Ipset)	
1706	DTOC Delay time $t_{I>>}$:	I>> DTOC	Time Setting (Tset)	
1703	DTOC Threshold operate value IN>	In> DTOC	Pickup Current (Ipset)	
1708	DTOC Delay time $t_{IN>}$:	In> DTOC	Time Setting (Tset)	
1709	DTOC Threshold operate value IN>>	In>> DTOC	Pickup Current (Ipset)	
1710	DTOC Delay time $t_{IN>>}$:	In>> DTOC	Time Setting (Tset)	
1776	Charac. angle α_G	Dir Ie	Max. Torque Angle(mtau)	In the "Voltage Polarizing" tab page
1777	Threshold operate value V_{N-G}>	Dir Ie	Polarizing voltage (upolu)	In the "Voltage Polarizing" tab page

To enable the DTOC (UMZ) mode disable the ”I> IDMT” and the ”In> IDMT” block and enable the ”I> DTOC” and the ”In> DTOC” block. To enable the IDMT (AMZ) mode enable the ”I> IDMT” and the ”In> IDMT” block and disable the ”I> DTOC” and the ”In> DTOC” block.

Breaker failure :

Address	Relay Setting	Model block	Model setting	Note
1720	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”
- ”Genstarting”
- ”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.

The ”Genstarting” relay output signal is the ”Starting” output signal and is *on* when at least one overcurrent element has started (current greater than its trip threshold).

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:

- User configurable *Tripping Matrix and Latch* (any overcurrent protective element trips the relay).
- *Hold time* $t_{I>hold}$ setting.
- *Measuring Circuit Monitoring*.
- Teleprotection feature.

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)

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. *AEG T&D PS 441 Directional Time-Overcurrent Protection Device SLTS.06.04761PDF/0597EN Ti*.

[2] 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. *Gerichtete Uberstromzeitschutzeinrichtung PS 441 Version - 301/- 302 - 401 - 603 89441-301/-302-401-603 / SLTS.12.05612*.