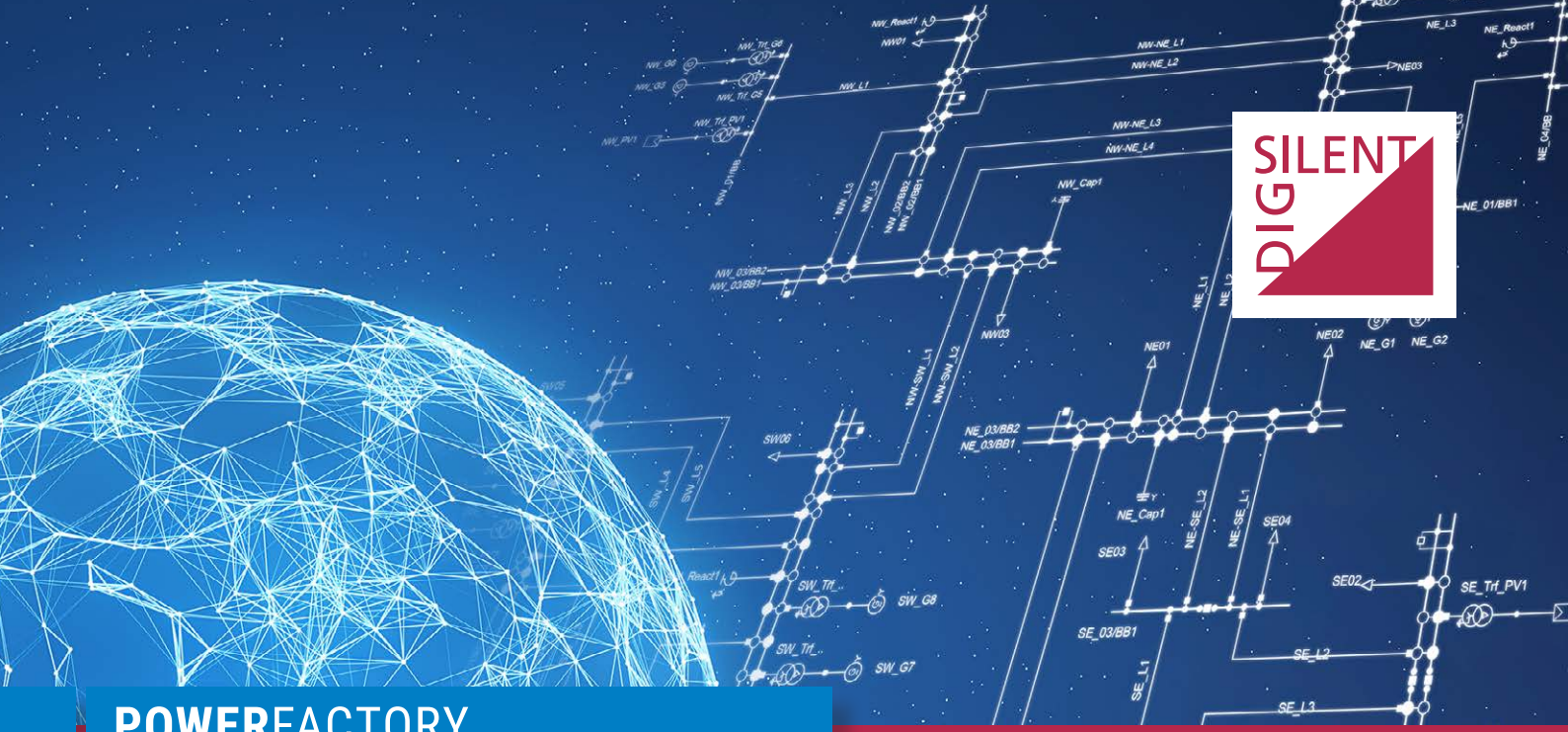

PowerFactory 2021

Technical Reference

Siemens 7SD50

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

1 Model information

Manufacturer Siemens

Model 7SD50

Variants This PowerFactory relay model type simulates the Siemens 7SD50 relay which is a 3 phase microprocessor 2 pilot wires differential relay protection suited to cable and line protection.

2 General description

The numerical current comparison protection 7SD50 is a fast and selective short circuit protection for cables and overhead lines. It is particularly suited to short lines where, for example, the first zone of a distance protection cannot be set sufficiently short. It can be used with lines down to any length. The current comparison protection system requires the installation of one 7SD50 unit at each end of the line; the two units exchange data by digital signals. If data transmission fails, the relay will switch automatically to an emergency mode. During this emergency period the relay operates as an overcurrent time protection which can be used as a definite time or inverse time overcurrent protection.

The Siemens 7SD50 relay has been modeled using one PowerFactory relay model which includes most of the features available in the relay.

The model implementation has been based on the information available in the relay documentation provided by the manufacturer and freely available [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 two elements which model two 3 phase CTs, and by an element which models a single phase (earth) CT; the secondary currents are then measured by two elements which simulate the digital filters of the relay.
Please notice that the second 3 phase transformer (*"Wd_2 Ct"* block) represents the measurement at the remote end of the line. No data link is modeled and only one Siemens 7SD50 relay model is required to simulate the whole differential arrangement at one side of the line.

3.1.1 Available Units

- Two 3 phase current transformers (*"Wd_1 Ct"* and *"Wd_2 Ct"* block).
- Four measurement elements (*"Measurement"*, *"Measurement 2nd harmonic"*, *"Measure 1"*, and *"Measure 2"* block).
- Two summation elements (*"Summation transformer local"* and *"Summation transformer remote"* block).

3.1.2 Functionality

The *"Wd_1 Ct"*, and the *"Wd_2 Ct"* 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 measurement blocks calculate the first harmonic component, except the *"Measurement 2nd harmonic"* block which calculates the 2_{nd} harmonic, using a DFT filter operating over a full cycle.

3.1.3 Data input

The CT secondary rated current (1 or 5 A) value must be set in the measurement elements (”Nominal current” parameter).

3.2 Protective elements

A differential element simulates the relay differential features. An additional overcurrent element (*"I1 release"* block) models the differential minimum current release threshold. An ancillary measurement block is used by the differential element to calculate the differential current RMS value (*"Differential RMS"* block).
Three phase overcurrent elements, and one thermal image element simulate the relay backup protective functions.

All protective functions available in the relay are available also in the PowerFactory relay model.

3.2.1 Available Units

- One 3 phase differential element (*"Differential"* block).
- One overcurrent release element (*"I1 release"* block).
- One ancillary measurement block (*"Differential RMS"*block).
- One 3 phase inverse time overcurrent element (*"Ip"* block).
- Two 3 phase definite time overcurrent element (*"I>"*, and *"I>>"* block).
- One thermal image element (*"Thermal overload"* block).

3.2.2 Functionality

The inverse time overcurrent element(*"Ip"* block) supports the following trip characteristics:

- Extremely inverse.
- Normally inverse.
- Very inverse.
- Definite time.

The relationship between current and time values for the *"Normal Inverse"*, *"Very Inverse"*, and *"Extremely Inverse"* characteristic complies with the IEC 60255-3 standards.

The differential element calculates for each phase the differential current in terms of current vector components (or instantaneous values during the EMT simulation) using the current values measured by *"Measure 1"* and by *"Measure 2"* block.

3.2.3 Data input

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

Address	Relay Setting	Model block	Model Parameter	Note
1501	CCP FUNCT.	Differential	Out of Service (outserv)	
1503	I> ST-STATE	Differential	Current threshold (IM)	
1506	SLOPE 1	Differential	Restraint 1st Slope (Irestr-percent1)	
1507	SLOPE 2	Differential	Restraint 2nd Slope (Irestr-percent2)	
1510	2nd HARMON	Differential	Disable Harmonic Blocking (harmblockdisable)	In the *Harmonic Blocking* tab page
1511	2nd HARMON	Differential	Threshold (H2threshold)	In the *Harmonic Blocking* tab page
1523	I1 RELEASE	I1 release	Pickup Current (Ipset)	
1525	T-DELAY	Differential	Time Setting (TSet)	
2601	EMER.O/C P	I>	Out of Service (outserv)	
		I>>	Out of Service (outserv)	
		Ip	Out of Service (outserv)	
2603	I>>	I>>	Pickup Current (Ipset)	
2604	T-I>>	I>>	Time Setting (Tset)	
2612	I>	I>	Pickup Current (Ipset)	
2613	T-I>	I>	Time Setting (Tset)	
2611	CHARACT.PH	Ip	Characteristic (pcharac)	
2614	Ip	Ip	Current Setting (Ipset)	
2615	T-Ip	Ip	Time Dial (Tpset)	
2701	THERMAL OL	Thermal overload	Out of Service (outserv)	
2702	K-FACTOR	Thermal overload	Current Setting (Ipset)	
2703	T-CONSTANT	Thermal overload	Time Dial (Tpset)	

3.3 Output logic

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

3.3.1 Available Units

- One output element (*"Logic"* block).

3.3.2 Functionality

The *"Logic"* block gets the trip signal coming from the differential element and the backup elements; it operates the relay output contact and the power breaker when at least one trip signal has been activated. The relay output contact is *yout*.

3.3.3 Data input

To disable completely the relay model ability to open the power circuit breaker disable the *"Logic"* block.

4 Features not supported

- Dynamic threshold (I> Dyn).
- Intertrip and transfertrip function.
- Remote link failure.
- Reclosing feature.
- Thermal current warning stage.

Please notice that in the relay model the overcurrent elements are always active or not active. To simulate the link failure the emergency protective blocks must be activated manually.

5 References

[1] Siemens, Erlangen. *NUMERICAL LINE DIFFERENTIAL PROTECTION WITH TWO PILOT WIRES 7SD502 V3.1 C53000 - G1176 - C95 - 4*, 1995.