



POWERFACTORY

PowerFactory 2021

Technical Reference

Siemens 7SJ8x

PF2021

POWER SYSTEM SOLUTIONS
MADE IN GERMANY

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Disclaimer

DlgSILENT protection device models are developed using publicly accessible information, such as user manuals, and are not validated or tested by the respective manufacturers.

1 Model information

Manufacturer Siemens

Model 7SJ8x

Variants The Siemens 7SJ8x PowerFactory relay models can be used to simulate a generic version of the Siemens 7SJ8 relay family (i.e. Siemens 7SJ82, 7SJ85, 7SJ86) in basic functionality. However please consider that, due to the high complexity of the relays, the models have been implemented with a reduced and simplified version of the available protective functions.

2 General Description

The Siemens 7SJ8x terminal current protection and current directional protection is a protective relay connections in networks of medium and high voltage. The Siemens 7SJ8x PowerFactory relay models is made in 3 variations:

- 7SJ8x Template 1
- 7SJ8x Template 2
- 7SJ8x Template 3

The 7SJ8x Template 1 relay model consists of a main relay and 2 subrelays. The model contains overcurrent protection, phases function (ANSI 50/51) and overcurrent protection, ground function (ANSI 50N / 51N), which are available in devices Siemens 7SJ82, 7SJ85 and 7SJ86.

The 7SJ8x Template 2 relay model consists of a main relay and 3 subrelays. The model contains overcurrent protection, phases function (ANSI 50/51), overcurrent protection, ground function (ANSI 50N / 51N) and directional overcurrent protection, phases function (ANSI 67), which are available in the device Siemens 7SJ86.

The 7SJ8x Template 3 relay model consists of a main relay and 4 subrelays. The model contains overcurrent protection, phases function (ANSI 50/51), overcurrent protection, ground function (ANSI 50N / 51N), directional overcurrent protection, phases function (ANSI 67) and directional overcurrent protection, ground function (ANSI 67N) which are available in Siemens 7SJ82 and 7SJ85 devices. The Siemens 7SJ8x PowerFactory relay models have been implemented to simulate the most commonly used protective functions.

The main relay contains the measurement and acquisition units, the subrelays, the input logic and the output logic. Up to seven different functional areas can be defined in the scheme:

- Measurement acquisition

- Overcurrent protection, phases function
- Overcurrent protection, ground function
- Directional overcurrent protection, phases function (only in 7SJ8x Template 2 and 7SJ8x Template 3)
- Directional overcurrent protection, ground function (only in 7SJ8x Template 3)
- Input of external blocking signals
- Output logic

Functions and model parameters are derived from information in [1] and [2].

3 Features Supported

3.1 Measurement and Acquisition

The voltage and the current are measured by one three phase current transformer ("*Ct-3p*" block), and one three phase voltage transformer ("*Vt*" block). The measurement unit "*Measurement*" is fed by this CT and this VT. An additional three phase/single phase current transformer ("*Ct-IGnd*" block) is measuring the zero sequence current and is feeding a separate measuring unit ("*Measure IGnd*" block). The relay input signals ("*BlockXXX_81*", where XXX - code protection stage) are present and can be used to block the protection stages.

3.1.1 Available Units and Input Signals

- One three phase current transformer ("*Ct-3p*" block)
- One three phase voltage transformer ("*Vt*" block) (only in 7SJ8x Template 2 and 7SJ8x Template 3)
- One three phase/single phase current transformer ("*Ct-IGnd*" block)
- One three phase measurement block calculating both the phase current and voltage values of the fundamental component ("*Measurement*" block)
- One single phase measurement block calculating the zero sequence current of the fundamental component ("*Measure IGnd*" block)
- Nine relay input signals ("*Block661_81*", "*Block662_81*", "*Block663_81*", "*Block664_81*", "*Block691_81*", "*Block751_81*", "*Block752_81*", "*Block753_81*", "*Block781_81*" signals)
- Five relay input signals ("*Block8131_81*", "*Block8132_81*", "*Block8133_81*", "*Block8134_81*", "*Block8161_81*" signals) (only in 7SJ8x Template 2 and 7SJ8x Template 3)
- Four relay input signals ("*Block4861_81*", "*Block4862_81*", "*Block4863_81*", "*Block4891_81*" signals) (only in 7SJ8x Template 3)

3.1.2 Functionality

The voltage and current input signals are sampled at 20 samples/cycle (this sampling rate is an adequate compromise between accuracy and the parallel processing of the functions); the values are processed by a DFT filter operating over a cycle which calculates then the voltage and current values used by the protective elements.

3.1.3 Data Input

The nominal current and the nominal voltage values MUST be entered in all the measurement blocks.

3.2 Main Relay Protective Elements

The main relay hosts a set of subrelays containing the overcurrent protective functions.

3.2.1 Available Units

- One phases overcurrent protection subrelay ("*Overcurrent Phases*" block)
- One ground overcurrent protection subrelay ("*Overcurrent Ground*" block)
- One phases directional overcurrent protection subrelay ("*Directional Overcurrent Phases*" block)(only in 7SJ8x Template 2 and 7SJ8x Template 3)
- One ground directional overcurrent protection subrelay ("*Directional Overcurrent Ground*" block)(only in 7SJ8x Template 3)
- One output element opening the associated breaker ("*Output Logic*" block)

3.2.2 Data Input

Address	Relay Setting	Model Unit	Model Parameter	Note
_:8881:102	CT 3-phase:Rated secondary current	Measurement	Nominal Current	
_:8881:102	CT 3-phase:Rated secondary current	Measure IGnd	Nominal Current	
_:8911:102	VT 3-phase:Rated secondary voltage	Measurement	Nominal Voltage	

3.3 Overcurrent Phases Subrelay

The *"Overcurrent Phases"* subrelay contains the phases overcurrent elements available in the Siemens 7SJ8x relay of the basic function type.

3.3.1 Available Units

- Four 3-phase definite time overcurrent elements (*"Definite-T 1"*, *"Definite-T 2"*, *"Definite-T 3"* and *"Definite-T 4"* block)
- One 3-phase inverse time overcurrent element (*"Inverse-T 1"* block)
- One output logic element (*"Output Logic"* block)

3.3.2 Data Input

Address	Relay Setting	Model Unit	Model Parameter	Note
_.661:1	Definite-T 1:Mode	Definite-T 1	Out of Service	
_.661:3	Definite-T 1:Threshold	Definite-T 1	Pickup Current	
_.661:6	Definite-T 1:Operate delay	Definite-T 1	Time Setting	
_.662:1	Definite-T 2:Mode	Definite-T 2	Out of Service	
_.662:3	Definite-T 2:Threshold	Definite-T 2	Pickup Current	
_.662:6	Definite-T 2:Operate delay	Definite-T 2	Time Setting	
_.663:1	Definite-T 3:Mode	Definite-T 3	Out of Service	
_.663:3	Definite-T 3:Threshold	Definite-T 3	Pickup Current	
_.663:6	Definite-T 3:Operate delay	Definite-T 3	Time Setting	
_.664:1	Definite-T 4:Mode	Definite-T 4	Out of Service	
_.664:3	Definite-T 4:Threshold	Definite-T 4	Pickup Current	
_.664:6	Definite-T 4:Operate delay	Definite-T 4	Time Setting	
_.691:1	Inverse-T 1:Mode	Inverse-T 1	Out of Service	
_.691:3	Inverse-T 1:Time dial	Inverse-T 1	Current Setting	
_.691:101	Inverse-T 1:Threshold	Inverse-T 1	Time Dial	
_.691:130	Inverse-T 1:Type of character. curve	Inverse-T 1	Characteristic	
_.691:131	Inverse-T 1:Reset	Inverse-T 1	Reset Characteristic	

3.4 Overcurrent Ground Subrelay

The *"Overcurrent Ground"* subrelay contains the ground overcurrent elements available in the Siemens 7SJ8x relay of the basic function type.

3.4.1 Available Units

- Three 3-phase definite time overcurrent elements (*"Definite-T 1"*, *"Definite-T 2"* and *"Definite-T 3"* block)
- One 3-phase inverse time overcurrent element (*"Inverse-T 1"* block)
- One output logic element (*"Output Logic"* block)

3.4.2 Data Input

Address	Relay Setting	Model Unit	Model Parameter	Note
_:751:1	Definite-T 1:Mode	Definite-T 1	Out of Service	
_:751:3	Definite-T 1:Threshold	Definite-T 1	Pickup Current	
_:751:6	Definite-T 1:Operate delay	Definite-T 1	Time Setting	
_:752:1	Definite-T 2:Mode	Definite-T 2	Out of Service	
_:752:3	Definite-T 2:Threshold	Definite-T 2	Pickup Current	
_:752:6	Definite-T 2:Operate delay	Definite-T 2	Time Setting	
_:753:1	Definite-T 3:Mode	Definite-T 3	Out of Service	
_:753:3	Definite-T 3:Threshold	Definite-T 3	Pickup Current	
_:753:6	Definite-T 3:Operate delay	Definite-T 3	Time Setting	
_:781:1	Inverse-T 1:Mode	Inverse-T 1	Out of Service	
_:781:3	Inverse-T 1:Time dial	Inverse-T 1	Current Setting	
_:781:101	Inverse-T 1:Threshold	Inverse-T 1	Time Dial	
_:781:130	Inverse-T 1:Type of character. curve	Inverse-T 1	Characteristic	
_:781:131	Inverse-T 1:Reset	Inverse-T 1	Reset Characteristic	

3.5 Directional Overcurrent Phases Subrelay

The *"Directional Overcurrent Phases"* subrelay contains the phases directional overcurrent elements available in the Siemens 7SJ8x relay of the basic function type. The *"Directional Overcurrent Phases"* subrelay is not a part of the 7SJ8x Template 1 model.

3.5.1 Available Units

- Four 3-phase definite time overcurrent elements (*"Definite-T 1"*, *"Definite-T 2"*, *"Definite-T 3"* and *"Definite-T 4"* block)
- One 3-phase inverse time overcurrent element (*"Inverse-T 1"* block)
- One directional element (*"Direction Determination"* block)
- One output logic element (*"Output Logic"* block)

3.5.2 Functionality

The *"Direction Determination"* block determines the direction by calculating the phase angle between short-circuit current and reference voltage.

The inverse time overcurrent element support the following trip characteristics:

- IEC 255-3 extremely inverse
- IEC 255-3 long inverse
- IEC 255-3 normal inverse
- IEC 255-3 very inverse
- ANSI/IEEE definite inverse
- ANSI/IEEE extremely inverse
- ANSI/IEEE inverse
- ANSI/IEEE long inverse
- ANSI/IEEE moderately inverse
- ANSI/IEEE short inverse
- ANSI/IEEE very inverse

3.5.3 Data Input

Address	Relay Setting	Model Unit	Model Parameter	Note
_:2311:102	General:Rotation angle of ref. volt.	Direction Determination	Max. Torque Angle	
_:8131:1	Definite-T 1:Mode	Definite-T 1	Out of Service	
_:8131:3	Definite-T 1:Threshold	Definite-T 1	Pickup Current	
_:8131:6	Definite-T 1:Operate delay	Definite-T 1	Time Setting	

3 Features Supported

Address	Relay Setting	Model Unit	Model Parameter	Note
_:8131:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_:8132:1	Definite-T 2:Mode	Definite-T 2	Out of Service	
_:8132:3	Definite-T 2:Threshold	Definite-T 2	Pickup Current	
_:8132:6	Definite-T 2:Operate delay	Definite-T 2	Time Setting	
_:8132:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_:8133:1	Definite-T 3:Mode	Definite-T 3	Out of Service	
_:8133:3	Definite-T 3:Threshold	Definite-T 3	Pickup Current	
_:8133:6	Definite-T 3:Operate delay	Definite-T 3	Time Setting	
_:8133:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_:8134:1	Definite-T 4:Mode	Definite-T 4	Out of Service	
_:8134:3	Definite-T 4:Threshold	Definite-T 4	Pickup Current	
_:8134:6	Definite-T 4:Operate delay	Definite-T 4	Time Setting	
_:8134:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_:8161:1	Inverse-T 1:Mode	Inverse-T 1	Out of Service	
_:8161:3	Inverse-T 1:Time dial	Inverse-T 1	Current Setting	
_:8161:101	Inverse-T 1:Threshold	Inverse-T 1	Time Dial	
_:8161:111	Inverse-T 1:Directional mode	Inverse-T 1	Tripping Direction	
_:8161:130	Inverse-T 1:Type of character. curve	Inverse-T 1	Characteristic	
_:8161:131	Inverse-T 1:Reset	Inverse-T 1	Reset Characteristic	

3.6 Directional Overcurrent Ground Subrelay

The *"Directional Overcurrent Ground"* subrelay contains the ground directional overcurrent elements available in the Siemens 7SJ8 relay of the basic function type. The *"Directional Overcurrent Ground"* subrelay is only available as part of the 7SJ8x Template 3 model.

3.6.1 Available Units

- Four 3-phase definite time overcurrent elements (*"Definite-T 1"*, *"Definite-T 2"*, *"Definite-T 3"* and *"Definite-T 4"* block)
- One 3-phase inverse time overcurrent element (*"Inverse-T 1"* block)
- One directional element (*"Direction Determination"* block)
- One output logic element (*"Output Logic"* block)

3.6.2 Functionality

The *"Direction Determination"* block determines the direction by calculating the phase angle between the short-circuit current 3I0 and the reference voltage V0.

3.6.3 Data Input

Address	Relay Setting	Model Unit	Model Parameter	Note
_.2311:102	General:Rotation angle of ref. volt.	Direction Determination	Max. Torque Angle	
_.4861:1	Definite-T 1:Mode	Definite-T 1	Out of Service	
_.4861:3	Definite-T 1:Threshold	Definite-T 1	Pickup Current	
_.4861:6	Definite-T 1:Operate delay	Definite-T 1	Time Setting	
_.4861:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_.4862:1	Definite-T 2:Mode	Definite-T 2	Out of Service	
_.4862:3	Definite-T 2:Threshold	Definite-T 2	Pickup Current	
_.4862:6	Definite-T 2:Operate delay	Definite-T 2	Time Setting	
_.4862:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_.4863:1	Definite-T 3:Mode	Definite-T 3	Out of Service	
_.4863:3	Definite-T 3:Threshold	Definite-T 3	Pickup Current	
_.4863:6	Definite-T 3:Operate delay	Definite-T 3	Time Setting	
_.4863:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_.4864:1	Definite-T 4:Mode	Definite-T 4	Out of Service	
_.4864:3	Definite-T 4:Threshold	Definite-T 4	Pickup Current	
_.4864:6	Definite-T 4:Operate delay	Definite-T 4	Time Setting	
_.4864:105	Definite-T 1:Directional mode	Definite-T 1	Tripping Direction	
_.4891:1	Inverse-T 1:Mode	Inverse-T 1	Out of Service	
_.4891:3	Inverse-T 1:Time dial	Inverse-T 1	Current Setting	
_.4891:101	Inverse-T 1:Threshold	Inverse-T 1	Time Dial	
_.4891:111	Inverse-T 1:Directional mode	Inverse-T 1	Tripping Direction	
_.4891:130	Inverse-T 1:Type of character. curve	Inverse-T 1	Characteristic	
_.4891:131	Inverse-T 1:Reset	Inverse-T 1	Reset Characteristic	

4 Available Mapping Files

Hardware Version	Firmware Version	Language	Multiple Setting Groups	Model
7.5	7.5	de		7SJ8x Template 1 7SJ8x Template 2 7SJ8x Template 3
		en		7SJ8x Template 1 7SJ8x Template 2 7SJ8x Template 3

5 References

- [1] Siemens AG. *SIPROTEC 5 Distance Protection, Line Differential Protection, and Overcurrent Protection for 3-Pole Tripping 7SA82, 7SD82, 7SL82, 7SA84, 7SD84, 7SA86, 7SD86, 7SL86, 7SJ86*. C53000-G5040-C010-9, Edition 11.2017.
- [2] Siemens AG. *SIPROTEC 5 Overcurrent Protection 7SJ82/7SJ85*. C53000-G5040-C017-8, Edition 11.2017.