



POWERFACTORY

PowerFactory 2021

Technical Reference

Siemens 7SJ63

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POWER SYSTEM SOLUTIONS
MADE IN GERMANY

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1 Model information

Manufacturer Siemens

Model 7SJ63

Variants These models can be used to simulate the features present in the Siemens SIPROTEC 7SJ63 protective relays up to firmware version V4.6.

2 General description

The numerical, multi-functional SIPROTEC 4 7SJ63 is a versatile device designed for many applications. The 7SJ63 can be used as a protective, control, and monitoring device for distribution feeders and transmission lines of any voltage in networks that are grounded, low-resistance grounded, ungrounded, or of a compensated neutral point structure. The device is suited for networks that are radial or looped, and for lines with single or multi-terminal feeds. The 7SJ63 is equipped with motor protection applicable for asynchronous machines of all sizes.

The Siemens 7SJ63 relay has been modeled using two PowerFactory relay models:

- 7SJ63_1A (phase and ground rated current equal to 1 A).
- 7SJ63_5A (phase and ground rated current equal to 5 A).

They include the phase, ground directional and non directional overcurrent protective elements, the thermal image element, the negative sequence elements, the overvoltage and the undervoltage elements available in the relay.

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

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 an element which simulates a 3 phase CT ("Ct-3p" block) ; the voltages are converted by an element which simulates a 3 phase VT ("Vt-3P" block); the secondary currents and voltages are then measured by one element which models the digital filter of the relay.

3.1.1 Available Units and input signals

- One 3 phase current transformer ("Ct-3p" block).
- One 3 phase voltage transformer ("Vt-3P" block).

- One 3 phase measurement element ("MeasPhase" block).
- One voltage sequence measurement element ("MeasSeq" block).

The following relay input signals can be used to block the protective elements:

- *I> 51 iblock* controlling the *Ip 51* element.
- *I> 67 TOC iblock* controlling *Ip 67 TOC* element.
- *I>> 50_1 iblock* controlling the *I> 50_1* element.
- *I>> 67_1 iblock* controlling *I> 67_1* element.
- *I>> 50_2 iblock* controlling the *I>> 50_2* element.
- *I>> 67_2 iblock* controlling *I>> 67_2* element.
- *Ie> 51N iblock* controlling the *Iep 51N* element.
- *Ie> 67N TOC iblock* controlling *Iep 67N TOC* element.
- *Ie>> 50N_1 iblock* controlling the *Ie> 50N_1* element.
- *Ie>> 67N_1 iblock* controlling *Ie> 67N_1* element.
- *Ie>> 50N_2 iblock* controlling the *Ie>> 50N_2* element.
- *Ie>> 67N_2 iblock* controlling *Ie>> 67N_2* element.

3.1.2 Functionality

The "Ct-3p" block represents an 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 input current values are sampled by the "MeasPhase" block at 16 samples/cycle. The values are processed by a digital filter, integrating the samples over a cycle, which then calculates the voltage and current RMS values used by the protective elements.

3.1.3 Data input

No manual data input is required. Please use the relay model which supports the setting ranges for the connected 3 phase Ct rated current.

3.2 Protective elements

A set of inverse time and definite time overcurrent elements is modeling the relay protective functions. The inverse characteristics available in the relay are available as well in the inverse time model blocks.

3.2.1 Available Units

- One 3 phase inverse time overcurrent element ("Ip 51" block).
- Two 3 phase definite time overcurrent elements ("I> 50_1", and "I>> 50_2" block).
- One ground current inverse time overcurrent element ("Iep 51N" block).
- Two ground current definite time overcurrent elements ("Ie> 50N_1", and "Ie>> 50N_2" block).
- One directional 3 phase inverse time overcurrent element ("Ip 67 TOC" block).
- Two directional 3 phase definite time overcurrent elements ("I> 67_1", and "I>> 67_2" block).
- One phase directional element ("Dir OC" block).
- One directional ground current inverse time overcurrent element ("Iep 67N TOC" block).
- Two directional ground current definite time overcurrent elements ("Ie> 67N_1", and "Ie>> 67N_2" block).
- One ground directional element ("Dir EF" block).
- One negative sequence current inverse time overcurrent element ("I2p 46 TOC" block).
- Two negative sequence current definite time overcurrent elements ("Ie> 46_1", and "Ie>> 46_2" block).
- One thermal image element ("Overload 49" block).
- Two phase-phase overvoltage elements ("U> 59_1" and "U>> 59_1" block).
- Two positive sequence undervoltage elements ("U< 27_1" and "U<< 27_1" block).

3.2.2 Functionality

The phase and the ground inverse time overcurrent elements ("Ip 51", "Ip 67 TOC", "Iep 51N", and "Iep 67N TOC" block) support the following trip characteristics:

- IEC Normal Inverse ("IEC 255-3 inverse" item).
- IEC Very Inverse ("IEC 255-3 very inverse" item).
- IEC Extremely Inverse ("IEC 255-3 extremely inverse" item).
- IEC Long Time Inverse ("IEC 255-3 long inverse" item).
- ANSI/IEEE Inverse ("ANSI/IEEE inverse" item).
- ANSI/IEEE Short inverse ("ANSI/IEEE short inverse" item).
- ANSI/IEEE Long inverse ("ANSI/IEEE long inverse" item).
- ANSI/IEEE Moderately inverse ("ANSI/IEEE moderately inverse" item).
- ANSI/IEEE Very inverse ("ANSI/IEEE very inverse" item).
- ANSI/IEEE Extremely inverse ("ANSI/IEEE extremely inverse" item).
- ANSI/IEEE Definite inverse ("ANSI/IEEE definite inverse" item).

- Definite time.
- User Defined 1.
- User Defined 2.
- User Defined 3.
- User Defined 4.
- User Defined 5.

The *User defined x* with $x =$ from 1 to 5 trip characteristics are defined by up to 23 current and time value couples which can be set by the user. The trip characteristic definitions are unique for any instance of the Siemens 7SJ63 relay model and be found in the *TCCs* folder contained inside the *7SJ63* relay model object.

The negative sequence inverse time overcurrent element ("I2p 46 TOC" block) supports the following trip characteristics:

- ANSI/IEEE Inverse ("ANSI/IEEE inverse" item).
- ANSI/IEEE Moderately inverse ("ANSI/IEEE moderately inverse" item).
- ANSI/IEEE Very inverse ("ANSI/IEEE very inverse" item).
- ANSI/IEEE Extremely inverse ("ANSI/IEEE extremely inverse" item).
- IEC Normal Inverse ("IEC 255-3 inverse" item).
- IEC Very Inverse ("IEC 255-3 very inverse" item).
- IEC Extremely Inverse ("IEC 255-3 extremely inverse" item).
- Definite time.

3.2.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
112	Charac. Phase	Ip 51	Out of Service (outserv)	When <i>Disabled</i> in the model put the block out of service
113	Charac. Ground	Ip 51 Iep 51N	Characteristic (pcharac) Out of Service (outserv)	When <i>Disabled</i> in the model put the block out of service
115	67/67TOC	Iep 51N Ip 67 TOC	Characteristic (pcharac) Out of Service (outserv)	When <i>Disabled</i> in the model put the block out of service
116	67N/67N TOC	I2p 67N TOC	Out of Service (outserv)	When <i>Disabled</i> in the model put the block out of service
131 140	Sens. Gnd Fault 46	Ilep 51Ns I2p 46 TOC	Characteristic (pcharac) Out of Service (outserv)	When <i>Disabled</i> in the model put the block out of service

3 Supported features

Address	Relay Setting	Model block	Model setting	Note
142	49	I2p 46 TOC	Characteristic (pcharac)	In the <i>Voltage Polarizing</i> tab page
150	2759	Overload 49	Out of Service (outserv)	
		U> 59_1	Out of Service (outserv)	
		U>> 59_2	Out of Service (outserv)	
		U< 27_1	Out of Service (outserv)	
		U<< 27_2	Out of Service (outserv)	
1201	FCT 5051	Ip 51	Out of Service (outserv)	
		I> 50_1	Out of Service (outserv)	
		I>> 50_2	Out of Service (outserv)	
1202	50-2 PICKUP	I>> 50_2	Current Pickup (Ipsetr)	
1203	50-2 DELAY	I>> 50_2	Time Setting (Tset)	
1204	50-1 PICKUP	I> 50_1	Current Pickup (Ipsetr)	
1205	50-1 DELAY	I> 50_1	Time Setting (Tset)	
1207	51 PICKUP	Ip 51	Current Setting (Ipsetr)	
1208	51 TIME DIAL	Ip 51	Time Dial (Tpset)	
1209	51 TIME DIAL	Ip 51	Time Dial (Tpset)	
1211	51 IEC CURVE	Ip 51	Characteristic (pcharac)	
1212	51 ANSI CURVE	Ip 51	Characteristic (pcharac)	
1301	FCT 50N/51N	Iep 51N	Out of Service (outserv)	
		Ie> 50N_1	Out of Service (outserv)	
		Ie>> 50N_2	Out of Service (outserv)	
1302	50N-2 PICKUP	Ie>> 50N_2	Current Pickup (Ipsetr)	
1303	50N-2 DELAY	Ie>> 50N_2	Time Setting (Tset)	
1304	50N-1 PICKUP	Ie> 50N_1	Current Pickup (Ipsetr)	
1305	50N-1 DELAY	Ie> 50N_1	Time Setting (Tset)	
1307	51N PICKUP	Iep 51N	Current Setting (Ipsetr)	
1308	51N TIME DIAL	Iep 51N	Time Dial (Tpset)	
1309	51N TIME DIAL	Iep 51N	Time Dial (Tpset)	
1311	51N IEC CURVE	Iep 51N	Characteristic (pcharac)	
1312	51N ANSI CURVE	Iep 51N	Characteristic (pcharac)	
1501	FCT 6767	Ip 67 TOC	Out of Service (outserv)	
		I> 67_1	Out of Service (outserv)	
		I>> 67_2	Out of Service (outserv)	
1502	67-2 PICKUP	I>> 67_2	Current Pickup (Ipsetr)	
1503	67-2 DELAY	I>> 67_2	Time Setting (Tset)	
1504	67-1 PICKUP	I> 67_1	Current Pickup (Ipsetr)	
1505	67-1 DELAY	I> 67_1	Time Setting (Tset)	
1507	67 PICKUP	Ip 67 TOC	Current Setting (Ipsetr)	
1508	67 TIME DIAL	Ip 67 TOC	Time Dial (Tpset)	
1509	67 TIME DIAL	Ip 67 TOC	Time Dial (Tpset)	
1511	67 IEC CURVE	Ip 67 TOC	Characteristic (pcharac)	
1512	67 ANSI CURVE	Ip 67 TOC	Characteristic (pcharac)	
1515	Normal Load	Dir OC	Max. Torque Angle (mtau)	
1516	67 Direction	Dir OC	Tripping Direction (idir)	
1601	FCT 67N/67N	Iep 67N TOC	Out of Service (outserv)	
		I> 67N_1	Out of Service (outserv)	
		I>> 67N_2	Out of Service (outserv)	
1602	67N-2 PICKUP	I>> 67N_2	Current Pickup (Ipsetr)	
1603	67N-2 DELAY	I>> 67N_2	Time Setting (Tset)	
1604	67N-1 PICKUP	I> 67N_1	Current Pickup (Ipsetr)	
1605	67N-1 DELAY	I> 67N_1	Time Setting (Tset)	
1607	67N PICKUP	Ip 67N TOC	Current Setting (Ipsetr)	
1608	67N TIME DIAL	Ip 67N TOC	Time Dial (Tpset)	
1609	67N TIME DIAL	Ip 67N TOC	Time Dial (Tpset)	
1611	67N IEC CURVE	Ip 67N TOC	Characteristic (pcharac)	

3 Supported features

Address	Relay Setting	Model block	Model setting	Note
1612	67N ANSI CURVE	Ip 67N TOC	Characteristic (pcharac)	In the <i>Voltage Polarizing</i> tab page
1615	Normal Load	Dir EF	Max. Torque Angle (mtau)	
1616	67N Direction		Tripping Direction (idir)	
4001	FCT 46	I2p 46 TOC	Out of Service (outserv)	
4002	46-2 PICKUP	I2>> 46_2	Current Pickup (Ipsetr)	
4003	46-2 DELAY	I2>> 46_2	Time Setting (Tset)	
4004	46-1 PICKUP	I2> 46_1	Current Pickup (Ipsetr)	
4005	46-1 DELAY	I2> 46_1	Time Setting (Tset)	
4006	46 IEC CURVE	I2p 46 TOC	Characteristic (pcharac)	
4007	46 ANSI CURVE	I2p 46 TOC	Characteristic (pcharac)	
4008	46 PICKUP	I2p 46 TOC	Current Setting (Ipsetr)	
4009	46 TIME DIAL	I2p 46 TOC	Time Dial (Tpset)	
4010	46 TIME DIAL	I2p 46 TOC	Time Dial (Tpset)	
4201	FCT 49	Overload 49	Out of Service (outserv)	
4202	49 K-FACTOR	Overload 49	Current Setting (Ipsetr)	
4203	TIME CONSTANT	Overload 49	Time Dial (Tpset)	
4207	Kt-FACTOR	Overload 49	Reset Delay (ResetT)	
5001	FCT 59	U> 59_1	Out of Service (outserv)	
		U>> 59_2	Out of Service (outserv)	
5002	59-1 PICKUP	U> 59_1	Pickup Voltage (Usetr)	
5003	59-1 PICKUP	U> 59_1	Pickup Voltage (Usetr)	
5004	59-1 DELAY	U> 59_1	Time Delay (Tdel)	
5005	59-2 PICKUP	U>> 59_2	Pickup Voltage (Usetr)	
5006	59-2 PICKUP	U>> 59_2	Pickup Voltage (Usetr)	
5007	59-2 DELAY	U>> 59_2	Time Delay (Tdel)	
5101	FCT 27	U< 27_1	Out of Service (outserv)	
		U<< 27_2	Out of Service (outserv)	
5102	27-1 PICKUP	U< 27_1	Pickup Voltage (Usetr)	
5103	27-1 PICKUP	U< 27_1	Pickup Voltage (Usetr)	
5106	27-1 DELAY	U< 27_1	Time Delay (Tdel)	
5110	27-2 PICKUP	U<< 27_2	Pickup Voltage (Usetr)	
5111	27-2 PICKUP	U<< 27_2	Pickup Voltage (Usetr)	
5112	27-2 DELAY	U<< 27_2	Time Delay (Tdel)	

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 Units

- one output element ("Logic" block)

3.3.2 Functionality

The "Logic" block collects the trip signals coming from the protective elements and operates the relay output contact. The only available output contact is *Trip*.

3.3.3 Data input

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

4 Features not supported

The following features are not supported:

- 50 1Ph-1 and 50 1Ph-2 element.
- Sensitive earth fault elements.
- Frequency elements (81).
- Disk emulation reset.
- Dynamic cold load pickup.
- 2nd harmonic blocking.
- Start inhibit for motors (66/68).
- Motor starting protection(48).
- Automatic reclosing (79).
- Breaker failure protection (50BF).

5 References

- [1] Siemens AG, Wittelsbacherplatz 2, 80333 Munich, Germany. *SIPROTEC Multi-Functional Protective Relay with Local Control 7SJ63 V4.2 Instruction Manual C53000-G1140-C120-2*, 1999.
- [2] Siemens AG, Wittelsbacherplatz 2, 80333 Munich, Germany. *SIPROTEC Multi-Functional Protective Relay with Local Control 7SJ62/63/64 V4.6 Manual C53000-G1140-C147-6*, 2004.