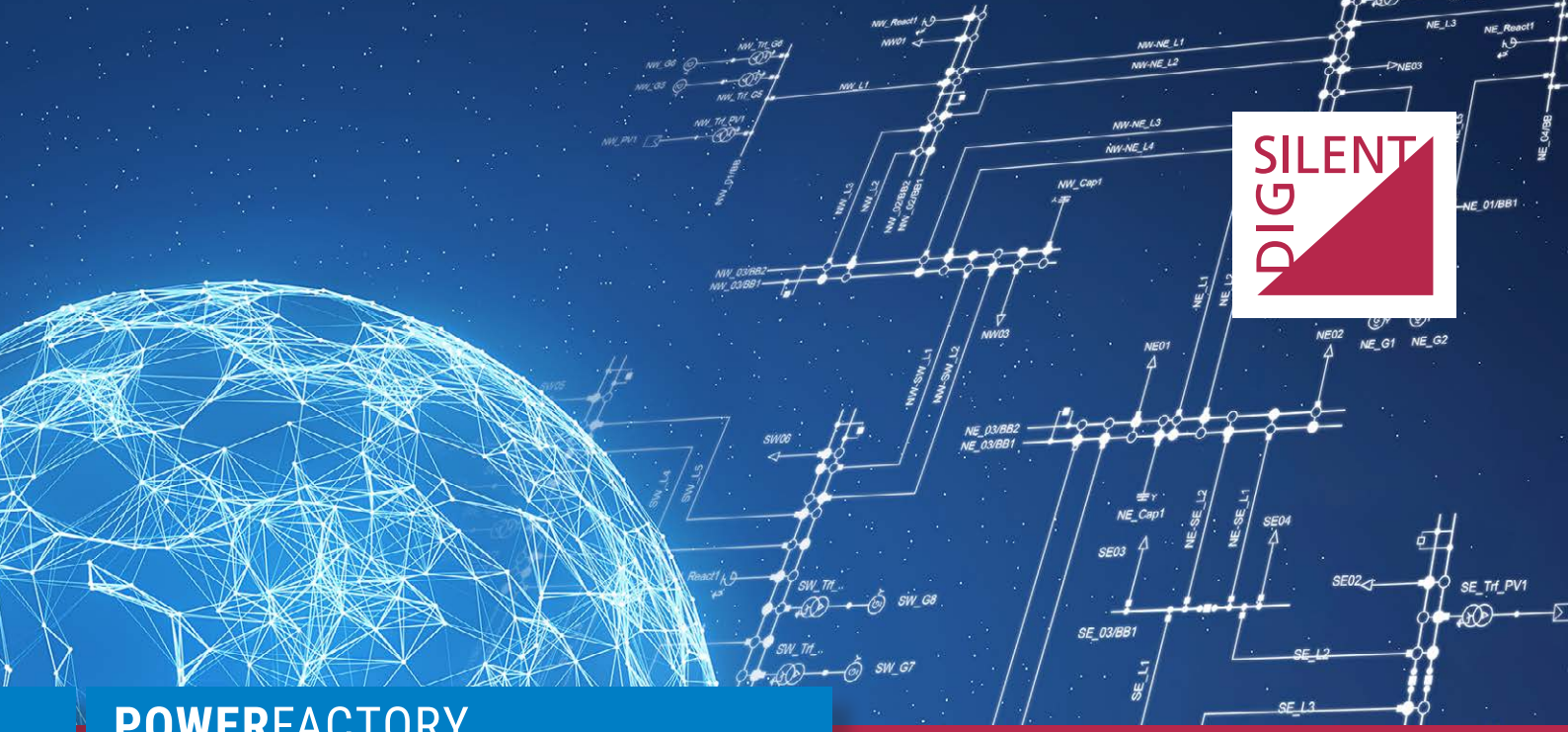

POWERFACTORY

PowerFactory 2021

Technical Reference

SEL 251

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

1 Model information

Manufacturer SEL

Model 251

Variants The SEL 251 PowerFactory relay models can be used to simulate the different firmware versions of the SEL 251 protective relays. The reference firmware version used to implement the models is SEL-251-3-R553. However please consider that the models have been implemented with a reduced set of the features available in the relays.

2 General description

The SEL 251 relay is a phase, negative sequence, residual ground overcurrent non directional protection relay. The directional control can be implemented using an external input signal or a simplified internal logic.

Please notice that the *251-1* version of the relay doesn't include the negative sequence protective elements but includes an additional set of ground overcurrent elements.

The SEL 251 PowerFactory relay models consist of a monolithic scheme.

The following model versions are available:

- SEL 251-1A
- SEL 251-5A

The relay models simulate most of the protective functions available in the SEL 251 relay: they consist of the measurement and acquisition units, the protective elements, the directional logic elements (including a couple of under voltage elements), the breaker failure feature and the output logic.

The model implementation has been based on the information available in the relay manual [1] [2] [3].

3 Supported features

3.1 Measurement and acquisition

The primary current is measured by one 3phase current transformer (”Ct” block), the primary voltage by one 3 phase voltage transformer (”Vt” block).

One measurement unit (”Meas I - DU” block) is fed by this CT and this VT.

3.1.1 Available Units

- One three phase current transformers measuring the phase current (”Ct” block).
- One three phase voltage transformer measuring the phase voltages(”Vt” block).
- One three phase measurement element calculating both the current and voltage values (”Meas I - DU” block).

3.1.2 Functionality

The input current and voltage values are sampled at 20 samples/cycle. The values are processed by a DFT filter, operating over a cycle, which then calculates the voltage and current values used by the protective elements.

3.1.3 Data input

Please select the relay version accordingly with the input rated current value (1 A or 5 A).

3.2 Main Relay protective elements

The overcurrent elements (with external input directional control), the recloser feature and directional logic elements are working together to simulate the SEL 251 protection functionalities.

3.2.1 Available Units

- One 3phase inverse time overcurrent elements (”51T” block).
- Two phase current definite time overcurrent elements (”50LT” and ”50H” block).
- One residual/ground current inverse time overcurrent element (”51GT” block, SEL 251-1 only).
- One residual/ground current define time overcurrent element (”50GT” block, SEL 251-1 only).
- One residual/ground current inverse time overcurrent element (”51NT” block).
- Two residual/ground current definite time overcurrent elements (”50NLT” and ”50H” block).
- One negative sequence current inverse time overcurrent element (”51QT” block, except SEL 251-1).
- One negative sequence current definite time overcurrent element (”50QT” block, except SEL 251-1).
- One logic element used to configure the torque control (directional) logic (”Int Torque Logic” block).
- Two phase-phase undervoltage definite time elements used by the *Internal Torque Control* logic(”27H” and ”27L” block).
- One 3phase current definite time overcurrent element used by the *Internal Torque Control* logic(”50C” block).
- One recloser element (”79” block).

3.2.2 Functionality

Overcurrent The inverse time elements (”51T”, ”51NT’ and ”51GT” block) are supporting the following inverse time trip characteristics:

- Moderately Inverse
- Inverse
- Very Inverse
- Extremely Inverse
- Short Time Inverse (SEL 251-1 only)

The inverse time element trip characteristic equations comply with the ANSI standard equations.

Both the one cycle delay reset and the electromechanical reset characteristic are available.

The ”50C” blocks doesn’t send any trip command to the power breaker. It can be used as part of the *Internal Torque Control* directional logic.

Directional feature The torque control can be made by the *External Torque Control* logic which uses the ”IN3” relay input signal or by the *Internal Torque Control* logic which can be configured to use the ”27” element or/and the ”50C” element.

Under voltage The undervoltage elements are not sending any trip command to the power breaker. The 27 element is asserting only if at least one phase-phase voltage is between the voltage threshold set in the ”27H” element and in the ”27L” element. It can be used as part of the *Internal Torque Control* directional logic.

Recloser Different *Open Interval times* can be inserted for each reclosing attempt. The reclosing logic can be defined in the *Logic* tab page. Different logics can be set for each overcurrent element.

The *Sequence Coordination* feature is also available.

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 :

Address	Relay Setting	Model block	Model setting	Note
	51P	51T	Current Setting (Ipsetr)	
	51C	51T	Characteristic(pcharac)	
	51TD	51T	Time Dial (Tpset)	
	51RS	51T	Reset Characteristic (resetdis)	
	51NP	51NT	Current Setting (Ipsetr)	
	51NC	51NT	Characteristic(pcharac)	
	51NTD	51NT	Time Dial (Tpset)	
	51NRS	51NT	Reset Characteristic (resetdis)	
	51GP	51GT	Current Setting (Ipsetr)	SEL 251-1 only
	51GC	51GT	Characteristic(pcharac)	SEL 251-1 only
	51GTD	51GT	Time Dial (Tpset)	SEL 251-1 only
	51GRS	51GT	Reset Characteristic (resetdis)	SEL 251-1 only
	51QP	51QT	Current Setting (Ipsetr)	
	51QC	51QT	Characteristic(pcharac)	
	51QTD	51QT	Time Dial (Tpset)	
	51QRS	51QT	Reset Characteristic (resetdis)	
	50L	50LT	Pickup Current (Ipsetr)	
	50LT	50LT	Time Setting (cTset)	
	50H	50H	Pickup Current (Ipsetr)	
	50N	50NT	Pickup Current (Ipsetr)	
	50NT	50NT	Time Setting (cTset)	
	50NH	50NH	Pickup Current (Ipsetr)	
	50G	50GT	Pickup Current (Ipsetr)	SEL 251-1 only
	50GT	50GT	Time Setting (cTset)	SEL 251-1 only
	50Q	50QT	Pickup Current (Ipsetr)	Except 251-1
	50QT	50QT	Time Setting (cTset)	Except 251-1

The electromechanical reset characteristic can be activated checking the ”Reset Characteristic’ check box in the ”51T”, ”51GT” (251-1 only), ”51NT” and ”51QT” (except 251-1) block. For any block the torque control must enabled selecting the ”External” item in the ”Directional” combobox.

Reclosing feature :

Address	Relay Setting	Model block	Model setting	Note
	79OI1	79	Reclosing interval 1 (crecltime1)	
	79OI2	79	Reclosing interval 2 (crecltime2)	
	79OI3	79	Reclosing interval 3 (crecltime3)	
	79OI4	79	Reclosing interval 4 (crecltime4)	
	79RSDT	79	Reset Time (cresetime)	
	SEQ(1)	79	Sequence Coordination (seqaccessory)	

Directional feature :

The ”External Torque Control” feature uses the relay ”IN3” input signal which must be connected to an external device which must provides the directional logic.

The ”Internal Torque Control” logic must be configured in the *Dip Settings* tab page (to enable the ”27” and/or the ”50C” element) and in the *Logic* tab page of the ”Int Torque Logic” block (to set the logic relationship between the status (trip or not trip) of the used elements).

Voltage :

Address	Relay Setting	Model block	Model setting	Note
	27L	27L	Pickup Voltage (Usetr)	
	27H	27H	Pickup Voltage (Usetr)	

3.3 Breaker failure

3.3.1 Available Units

The Circuit breaker failure protection feature is modeled by the ”TFT” block.

3.3.2 Functionality

The ”TFT” block is a timer which is operating the ”Alarm” relay output signal when the trip signal is still present after *TFT* (relay setting) seconds that the ”yout” output signal has been activated. The activated signal can be modified changing the logic available in the *Logic* tab page of the ”Output Logic” block.

3.3.3 Data Input

Please insert the *TFT* relay setting as ”Time setting” (”Tcdelay”) of the ”TFT” block in the PF relay model.

3.4 Output logic

The output logic is the interface between the relay and the power system. A set of relay output signals is available and can be configured by the user to implement any control logic.

3.4.1 Available Units and Signals

The trip logic is implemented by the ”Trip logic” and by the ”Output logic” block, the reclosing logic by the ”Closing Logic” block.

The following relay output signals are available:

- *yout* ”Closing Logic” output signal
- *A1* ”Output logic” output signal
- *A2* ”Output logic” output signal
- *A3* ”Output logic” output signal
- *A4* ”Output logic” output signal
- *Alarm* ”Output logic” output signal
- *_TRIP* ”Output logic” output signal

3.4.2 Functionality

The ”Output Logic” block operates the power breaker when a trip command has been issued by any protective element. The ”Closing logic” block closes the power breaker when the recloser block triggers a reclosing attempt.

The signal operating the breaker is ”_TRIP”; the relay output signal logic can be configured in the *Logic* tab page of the ”Output logic” block modeling any special logic implemented in the relay by a SELOGIC control equations.

3.4.3 Data input

Please disable the ”Output Logic” block to disable the relay model ability to open the power circuit.

4 Features not supported

The following features are not supported:

- Fault locator.
- Multiple setting groups.
- Detection of operation of the transformer high side fuses.
- 52A element.
- General purpose timers.

5 References

[1] SCHWEITZER ENGINEERING LABORATORIES, 2350 NE HOPKINS COURT PULLMAN, WA USA 99163-5603. *SEL-251 Distribution Relay rev 5*, 1996.

[2] SCHWEITZER ENGINEERING LABORATORIES, 2350 NE HOPKINS COURT PULLMAN, WA USA 99163-5603. *SEL-251-0-2-3 DISTRIBUTION RELAY PHASE OVERCURRENT RELAY WITH VOLTAGE CONTROL NEGATIVE-SEQUENCE OVERCURRENT RELAY GROUND OVERCURRENT RELAY MULTIPLE SHOT RECLOSING RELAY SELECTABLE SETTING GROUP CIRCUIT BREAKER MONITOR FAULT LOCATOR SELogic CONTROL EQUATION INSTRUCTION MANUAL Date Code 20020212*, February 2002.

[3] SCHWEITZER ENGINEERING LABORATORIES, 2350 NE HOPKINS COURT PULLMAN, WA USA 99163-5603. *SEL-251-1 DISTRIBUTION RELAY PHASE OVERCURRENT GROUND OVERCURRENT MULTIPLE SHOT RECLOSING RELAY SELECTABLE SETTING GROUP CIRCUIT BREAKER MONITOR FAULT LOCATOR SELogic CONTROL EQUATION INSTRUCTION MANUAL Date Code 20020212*, February 2002.