



POWERFACTORY

PowerFactory 2021

Technical Reference

SEL 787

PF2021

POWER SYSTEM SOLUTIONS
MADE IN GERMANY

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1 Model information

Manufacturer SEL

Model 787

Variants The SEL 787 consists of one set of PowerFactory relay models, comprised of a 1A and a 5A version. The provided measurement inputs are intended for 2W-transformer protection. The manual/firmware date code used as reference is "20130426".

Modelled Functionality

Functionality	
Differential Element	X
Restricted Earth Fault Element	X
Overcurrent Elements	X
Time-Overcurrent Elements	X
RTD Input Function	-
Undervoltage Function	X
Overvoltage Function	X
Volts per Hertz Function	X
Power Elements	X
Frequency Elements	X
Loss-of-Potential (LOP) Protection	-

2 General description

Each model consists of a main relay with several sub-functions.

- Main relay : Measurement transformer slots, differential protection, breaker logics
- Frequency : Frequency protection
- Power : Over-/Underpower protection
- REF : Restricted earth fault protection
- Voltage : Over-/Undervoltage protection
- Volts per Hertz : Over-/Undervoltage protection
- Wd-X OC : Overcurrent protection for winding X
- Wd-X Meas : Measurement processing for winding X

3 Main relay

Instrument transformers

The "Wd-1 Ct", "Wd-2 Ct" and "Vt" slots hold the assigned 3-phase instrument transformers. The "Neutral Ct" holds the summation current transformer for the restricted earth fault protection. Please note, that the zero sequence current for the overcurrent elements will always be calculated from the phase CTs.

Measurement units

The "Wd-1 Meas" and "Wd-2 Meas" sub-relays hold the measurement units processing the transformer inputs and providing nominal current and voltage values. Please note, that the current is fixed for each model (1A or 5A), but the nominal voltage of the relay should be entered in all measurement units. Additionally the phase correction for the CTs can be configured here.

Address	Relay Setting	Model unit	Model parameter
W1CT	WDG1 CT CON	Wd-1 Meas\Wd Adapter	Current Transformer Connection
W2CT	WDG2 CT CON	Wd-2 Meas\Wd Adapter	Current Transformer Connection
CTR1	WDG1 PHASE CTR	Wd-1 Meas\Wd Adapter	Current Transformer Ratio
CTR2	WDG2 PHASE CTR	Wd-2 Meas\Wd Adapter	Current Transformer Ratio
W1CTC	WDG1 CT COMP	Wd-1 Meas\Wd Adapter	Transformer Group
W2CTC	WDG2 CT COMP	Wd-2 Meas\Wd Adapter	Transformer Group
VWDG1	WDG1 L-L VOLTS	Wd-1 Meas\Wd Adapter	Nominal Terminal Line-Line Voltage
VWDG2	WDG2 L-L VOLTS	Wd-2 Meas\Wd Adapter	Nominal Terminal Line-Line Voltage

Differential

The "Differential" unit models the main protection function of the SEL 787 . Please note, that the "Harmonic restraint", as well as the alarm modes are not modelled.

Address	Relay Setting	Model unit	Model parameter
E87	XFMR DIFF ENABLE	Differential	Out of Service
TAP1	WDG1 CURR TAP	Differential	Tap 1
TAP2	WDG2 CURR TAP	Differential	Tap 2
MVA	MAX XFMR CAP	Differential	Max. Rated Power
O87P	OPERATE CURR LVL	Differential	Release Threshold
SLP1	RESTRAINT SLOPE1	Differential	Restraint 1st Slope
SLP2	RESTRAINT SLOPE2	Differential	Restraint 2nd Slope
IRS1	RES SLOPE1 LIMIT	Differential	Restraint 2nd Slope Threshold
U87P	UNRES CURR LVL	Differential	Unrestrained Differential Threshold
PCT2	2ND HARM BLOCK	Differential	2nd Harmonic Blocking Threshold
PCT4	4TH HARM BLOCK	Differential	4th Harmonic Blocking Threshold
PCT5	5TH HARM BLOCK	Differential	5th Harmonic Blocking Threshold
HBLK	HARMONIC BLOCK	Differential	Disable Harmonic Blocking

Breaker logics

The "Logic" unit holds the breakers to be operated on relay trips.

4 Frequency

The "Frequency" sub-relay contains the over-/underfrequency protection.

Address	Relay Setting	Model unit	Model parameter
81D1TP	FREQ1 TRIP LEVEL	81D1	Frequency
81D1TD	FREQ1 TRIP DELAY	81D1	Time Delay
81D2TP	FREQ2 TRIP LEVEL	81D2	Frequency
81D2TD	FREQ2 TRIP DELAY	81D2	Time Delay
81D3TP	FREQ3 TRIP LEVEL	81D3	Frequency
81D3TD	FREQ3 TRIP DELAY	81D3	Time Delay
81D4TP	FREQ4 TRIP LEVEL	81D4	Frequency
81D5TD	FREQ4 TRIP DELAY	81D4	Time Delay

5 Power

The "Power" sub-relay contains the over-/underpower protection.

Address	Relay Setting	Model unit	Model parameter
3PWR1P	3PH PWR ELEM PU	P1> Q1>	Input Setting
PWR1T	PWR ELEM TYPE	P1> Q1>	see 1)
PWR1D	PWR ELEM DELAY	P1> Q1>	Time Dial
3PWR2P	3PH PWR ELEM PU	P2> Q2>	Input Setting
PWR2T	PWR ELEM TYPE	P2> Q2>	see 1)
PWR2D	PWR ELEM DELAY	P2> Q2>	Time Dial

Notes:

- 1) – "+WATTS" - Set PX> in service and *Tripping Direction* to "Forward"
- "-WATTS" - Set PX> in service and *Tripping Direction* to "Reverse"
- "+VARS" - Set QX> in service and *Tripping Direction* to "Forward"
- "-VARS" - Set QX> in service and *Tripping Direction* to "Reverse"

6 REF

The "REF" subrelay contains the units for the restricted earth fault protection. Please note, that the REF protection will always use "Wd-1 Ct" for the phase currents and "Neutral Ct" for the

8 Volts per Hertz

residual current.

Address	Relay Setting	Model unit	Model parameter
50REF1P	REF1 CURR LEVEL	REF REF TOC	Release Threshold Current Setting

7 Voltage

The "Voltage" sub-relay contains the over-/undervoltage protection. Please note, that the Phase OV/UV protection will always use Phase-Earth values, regardless of the connection of the selected voltage transformer.

Address	Relay Setting	Model unit	Model parameter
27P1P	PHASE UV LEVEL	Phase UV 1	Input Setting
27P1D	PHASE UV DELAY	Phase UV 1	Time Dial
27P2P	PHASE UV LEVEL	Phase UV 2	Input Setting
27P2D	PHASE UV DELAY	Phase UV 2	Time Dial
59P1P	PHASE OV LEVEL	Phase OV 1	Input Setting
59P1D	PHASE OV DELAY	Phase OV 1	Time Dial
59P2P	PHASE OV LEVEL	Phase OV 2	Input Setting
59P2D	PHASE OV DELAY	Phase OV 2	Time Dial
59Q1P	NSEQ OV LEVEL	NSEQ OV 1	Input Setting
59Q1D	NSEQ OV DELAY	NSEQ OV 1	Time Dial
59Q2P	NSEQ OV LEVEL	NSEQ OV 2	Input Setting
59Q2D	NSEQ OV DELAY	NSEQ OV 2	Time Dial

8 Volts per Hertz

The "Volts per Hertz" sub-relay contains the overexcitation protection. Please note, that the unit will always use Phase-Earth values, regardless of the connection of the selected voltage transformer. Only the trip curve ("*Level 2*") is modelled.

Address	Relay Setting	Model unit	Model parameter
24CCS	LVL2 CURVE SHAPE	24D1 24D2	Characteristic
24IP	LVL2 INV-TM PU	24D1	Input Setting
24IC	LVL2 INV-TM CURV	24D1	Characteristic
24ITD	LVL2 INV-TM FCTR	24D1	Time Dial
24D2P1	LVL2 PICKUP 1	24D1	Input Setting
24D2D1	LVL2 TIME DLY1	24D1	Time Dial
24D2P2	LVL2 PICKUP 2	24D2	Input Setting
24D2D2	LVL2 TIME DLY2	24D2	Time Dial
24CR	LVL2 RESET TIME	24D1 24D2	Reset Delay

9 Overcurrent protection

The "Wd-1 OC" and "Wd-2 OC" sub-relays hold the per winding (time-) overcurrent protection. Please note, that time adder and reset emulation are not modelled for inverse characteristics.

Address	Relay Setting	Model unit	Model parameter
50Pn1P	PHASE IOC LEVEL	Wd-n Meas\50Pn1	Pickup Current
50Pn1D	PHASE IOC DELAY	Wd-n Meas\50Pn1	Time Setting
50Pn2P	PHASE IOC LEVEL	Wd-n Meas\50Pn2	Pickup Current
50Pn2D	PHASE IOC DELAY	Wd-n Meas\50Pn2	Time Setting
50Pn3P	PHASE IOC LEVEL	Wd-n Meas\50Pn3	Pickup Current
50Pn3D	PHASE IOC DELAY	Wd-n Meas\50Pn3	Time Setting
50Pn4P	PHASE IOC LEVEL	Wd-n Meas\50Pn4	Pickup Current
50Pn4D	PHASE IOC DELAY	Wd-n Meas\50Pn4	Time Setting
50Gn1P	RES IOC LEVEL	Wd-n Meas\50Gn1	Pickup Current
50Gn1D	RES IOC DELAY	Wd-n Meas\50Gn1	Time Setting
50Gn2P	RES IOC LEVEL	Wd-n Meas\50Gn2	Pickup Current
50Gn2D	RES IOC DELAY	Wd-n Meas\50Gn2	Time Setting
50Qn1P	NSEQ IOC LEVEL	Wd-n Meas\50Qn1	Pickup Current
50Qn1D	NSEQ IOC DELAY	Wd-n Meas\50Qn1	Time Setting
50Qn2P	NSEQ IOC LEVEL	Wd-n Meas\50Qn2	Pickup Current
50Qn2D	NSEQ IOC DELAY	Wd-n Meas\50Qn2	Time Setting
51PnP	PHASE TOC LEVEL	Wd-n Meas\51Pn	Current Setting
51PnC	PHASE TOC CURVE	Wd-n Meas\51Pn	Characteristic
51PnTD	PHASE TOC TDIAL	Wd-n Meas\51Pn	Time Dial
51PnAP	PHASE TOC LEVEL	Wd-n Meas\51PnA	Current Setting
51PnAC	PHASE TOC CURVE	Wd-n Meas\51PnA	Characteristic
51PnATD	PHASE TOC TDIAL	Wd-n Meas\51PnA	Time Dial
51PnBP	PHASE TOC LEVEL	Wd-n Meas\51PnB	Current Setting
51PnBC	PHASE TOC CURVE	Wd-n Meas\51PnB	Characteristic
51PnBTD	PHASE TOC TDIAL	Wd-n Meas\51PnB	Time Dial
51PnCP	PHASE TOC LEVEL	Wd-n Meas\51PnC	Current Setting
51PnCC	PHASE TOC CURVE	Wd-n Meas\51PnC	Characteristic
51PnCTD	PHASE TOC TDIAL	Wd-n Meas\51PnC	Time Dial
51GnP	RES TOC LEVEL	Wd-n Meas\51Gn	Current Setting
51GnC	RES TOC CURVE	Wd-n Meas\51Gn	Characteristic
51GnTD	RES TOC TDIAL	Wd-n Meas\51Gn	Time Dial
51QnP	NSEQ TOC LEVEL	Wd-n Meas\51Qn	Current Setting
51QnC	NSEQ TOC CURVE	Wd-n Meas\51Qn	Characteristic
51QnTD	NSEQ TOC TDIAL	Wd-n Meas\51Qn	Time Dial