

The logo for Silent DIG, featuring the word "SILENT" in white capital letters above the word "DIG" in red capital letters, all contained within a white square with a red diagonal stripe.The logo for PowerFactory, consisting of the word "POWERFACTORY" in white capital letters on a blue rectangular background.

PowerFactory 2021

Technical Reference

ABB DPU 2000R

POWER SYSTEM SOLUTIONS
MADE IN GERMANY

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1 Model information

Manufacturer ABB

Model DPU 2000R

Variants These PowerFactory models simulate most of the features available in the ABB DPU 2000 and DPU 2000R protective relays.

2 General description

The ABB DPU 2000R relay has been modeled using four PowerFactory relay models: 2 models simulate the relay versions using the IEC inverse time trip characteristics, 2 models the relay versions using the ANSI inverse time trip characteristics; the models are placed in two PowerFactory folders named "1 Amp" where the models with a measurement secondary rated current equal to 1 A can be found and "5 Amp" where the models with a measurement secondary rated current equal to 5 A can be found. In each directory the following relay models can be found:

- DPU2000R_ANSI simulating the relay using the ANSI inverse time trip characteristics
- DPU2000R_IEC simulating the relay using the IEC inverse time trip characteristics

The model implementation has been based on the information available in the relay manual [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 an element simulating a 3 phase CT and by an element simulating a core CT; the system voltages are converted by an element simulating a 3 phase VT and by an element simulating a open delta VT. the secondary currents and voltages are then measured by some measurement elements modeling the analog filters of the relay.

3.1.1 Available Units

- one 3ph current transformer ("Ct-3p" block)
- one single phase current transformer("Ct-E/N" block) simulating a core CT
- one 3ph voltage transformer ("Vt-3p" block)
- one open delta voltage transformer("Vt-0" block)
- one phase measurement element ("Measure Ph" block)

- one sequence measurement element ("Measure Seq" block) calculating both the current and the phase sequence values
- one frequency measurement element ("Meas Freq" block)

3.1.2 Functionality

The "Ct-3p" and the "Ct-E/N" block represent an ideal CT. 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 block simulates a second order low pass analog filter with DC component filter; its time constant is 10 ms.

3.1.3 Data input

No manual data input is required in the measurement blocks.

If no core CT is available assign the 3 phases CT also to the "Ct-E/N" slot. If no open delta VT is available assign the 3 phases VT also to the "Vt-0" slot.

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("51P (3I>)" block)
- one zero sequence inverse time overcurrent element("51N (IN>)" block)
- three phase definite time overcurrent elements ("50P1 (3I>>1)", "50P1 (3I>>2)" and "50P1 (3I>>3)" block)
- three zero sequence definite time overcurrent elements ("50N1 (IN>>1)", "50N1 (IN>>2)" and "50N1 (IN>>3)" block)
- two negative sequence inverse time overcurrent elements ("46 (Insc>)" and "46A (InscA>)" block)
- one 3 phase directional inverse time overcurrent element("67P (3I>>)" and "Dir OC" block)
- one zero sequence directional inverse time overcurrent element("67N (IN>->)" and "Dir EF" block)
- four definite time frequency elements ("81R1", "81R2", "81S1" and "81S2" block)
- one 3phase overvoltage element ("59-1 (U>)" block)

- one 3phase undervoltage element ("27-1 (U<)" block)
- one zero sequence overvoltage element ("59G (U>)" block)
- one zero sequence overvoltage element ("47 (U>)" block)
- one reclosing element ("Reclosing" block)

3.2.2 Functionality

The "DPU2000R_ANSI" model inverse time overcurrent elements support the following trip characteristics:

- ANSI extremely inverse
- ANSI inverse
- ANSI long time ext inv (long time extremely inverse)
- ANSI long time inverse
- ANSI long time very inverse
- ANSI recloser curve # 8
- ANSI short time inverse
- ANSI very inverse
- Definite time (51)
- Standard Instantaneous ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)
- Inverse Instantaneous ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)
- ANSI short time inverse ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)
- ANSI short time ext inv ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)
- Definite time (50) ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)

The "DPU2000R_IEC" model inverse time overcurrent elements support the following trip characteristics:

- IEC inverse
- IEC very inverse
- IEC extremely inverse
- IEC long time inverse
- Definite time (51)
- Standard Instantaneous ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)
- Definite time (50) ("50N1 (IN>>1)" and "50P1 (3I>>1)" block)

3.2.3 Data input

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

3 Supported features

Address	Relay Setting	Model block	Model setting	Note
	51P (3I>) Curve	51P (3I>)	Characteristic	Set only with the Definite Time curve
	51P (3I>) Pickup	51P (3I>)	Current Setting	
	51P (3I>) Time Dial	51P (3I>)	Time Dial	
	51P (3I>) Time Delay	51P (3I>)	Time Dial	
	51N (IN>) Curve	51N (IN>)	Characteristic	Set only with the Definite Time curve
	51N (IN>) Pickup	51N (IN>)	Current Setting	
	51N (IN>) Time Dial	51N (IN>)	Time Dial	
	51N (IN>) Time Delay	51N (IN>)	Time Dial	
	50P-1 (3I>>1) Curve	50P-1 (3I>>1)	Characteristic	Set only with the Definite Time curve
	50P-1 (3I>>1) Pickup	50P-1 (3I>>1)	Current Setting	
	50P-1 (3I>>1) Time Dial	50P-1 (3I>>1)	Time Dial	
	50N-1 (IN>>1) Curve	50N-1 (IN>>1)	Characteristic	
	50N-1 (IN>>1) Pickup	50N-1 (IN>>1)	Current Setting	
	50N-1 (IN>>1) Time Dial	50N-1 (IN>>1)	Time Dial	
	50P-2 (3I>>2) Pickup	50P-2 (3I>>2)	Pickup Current	
	50P-2 (3I>>2) Time Delay	50P-2 (3I>>2)	Time Setting	
	50N-2 (IN>>2) Pickup	50N-2 (IN>>2)	Pickup Current	
	50N-2 (IN>>2) Time Delay	50N-2 (IN>>2)	Time Setting	
	50P-3 (3I>>3) Pickup	50P-3 (3I>>3)	Pickup Current	
	50N-3 (IN>>3) Pickup	50N-3 (IN>>3)	Pickup Current	
	67P (3I>-->) Curve	67P (3I>-->)	Characteristic	
	67P (3I>-->) Pickup	67P (3I>-->)	Current Setting	
	67P (3I>-->) Time Dial	67P (3I>-->)	Time Dial	
	67P (3I>-->) Time Delay	67P (3I>-->)	Time Dial	
	67P (3I>-->) Maximum Torque angle	Dir OC	Max Torque Angle	Set only with the Definite Time curve "Voltage Polarizing" tab page
	67N (IN>-->) Curve	67N (IN>-->)	Characteristic	
	67N (IN>-->) Pickup	67N (IN>-->)	Current Setting	
	67N (IN>-->) Time Dial	67N (IN>-->)	Time Dial	
	67N (IN>-->) Time Delay	67N (IN>-->)	Time Dial	Set only with the Definite Time curve "Voltage Polarizing" tab page
	67N (IN>-->) MAx Torque angle	Dir EF	Max Torque Angle	
	79M Reset time Pickup	Reclosing	Reset Time	
	79M Open interval time	Reclosing	Reclosing Interval 1	
		Reclosing	Reclosing Interval 2	Set "Number of reclosures" + 1
		Reclosing	Reclosing Interval 3	
	79M Number of reclosures	Reclosing	Operations to lockout	
	81R1 Load Shed pickup	81R1	Frequency	
	81R1 Shed time delay	81R1	Time Delay	Set only with the Definite Time curve
	81R2 Load Shed pickup	81R2	Frequency	
	81R2 Shed time delay	81R2	Time Delay	
	81S1 Load Shed pickup	81S1	Frequency	
	81S1 Shed time delay	81S1	Time Delay	
	81S2 Load Shed pickup	81S2	Frequency	
	81S2 Shed time delay	81S2	Time Delay	
	46 (Insc>) Curve	46 (Insc>)	Characteristic	
	46 (Insc>) Pickup	46 (Insc>)	Current Setting	
	46 (Insc>) Time Dial	46 (Insc>)	Time Dial	
	46 (Insc>) Time Delay	46 (Insc>)	Time Dial	

3 Supported features

Address	Relay Setting	Model block	Model setting	Note
	46A (InscA>) Curve	46A (InscA>)	Characteristic	Set only with the Definite Time curve
	46A (InscA>) Pickup	46A (InscA>)	Current Setting	
	46A (InscA>) Time Dial	46A (InscA>)	Time Dial	
	46A (InscA>) Time Delay	46A (InscA>)	Time Dial	
	27-1 (U<) Pickup	27-1 (U<)	Pickup Voltage	
	27-1 (U<) Time Delay	27-1 (U<)	Time Delay	
	59-1 (U>) Pickup	59-1 (U>)	Pickup Voltage	
	59-1 (U>) Time Delay	59-1 (U>)	Time Delay	
	47 Pickup	47 (U>)	Pickup Voltage	
	47 Time Delay	47 (U>)	Time Delay	
	59G Pickup	59G (U>)	Pickup Voltage	
	59G Time Delay	59G (U>)	Time Delay	

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 ("Trip Logic" block)

3.3.2 Functionality

The "Trip Logic" block is collecting the trip signals coming from the protective elements and is operating the relay output contact. The output contact is named "Trip".

3.3.3 Data input

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

4 Features not supported

The following features are not supported:

- Distance protection ("21-1", "21-2", "21-3" and "21-4" element)
- Power Directional Function: 32P and 32N
- Negative sequence polarized directional feature
- Cutout time function
- Cold Load Pickup Time Delay
- Two-Phase 50P (3I>>) Tripping
- Programmable curves
- Frequency element Voltage Block, Load Restoration, Restoration T.D.
- 59-3 and 27-3 protective functions (under voltage and over voltage elements tripping only when all phase voltages are below/above the given threshold)

5 References

- [1] ABB, 7036 Snowdrift Road, Allentown Pennsylvania USA. *ABB Distribution Relay System Descriptive Bulletin DPU 2000R 41-219M, August 2003, 2003.*