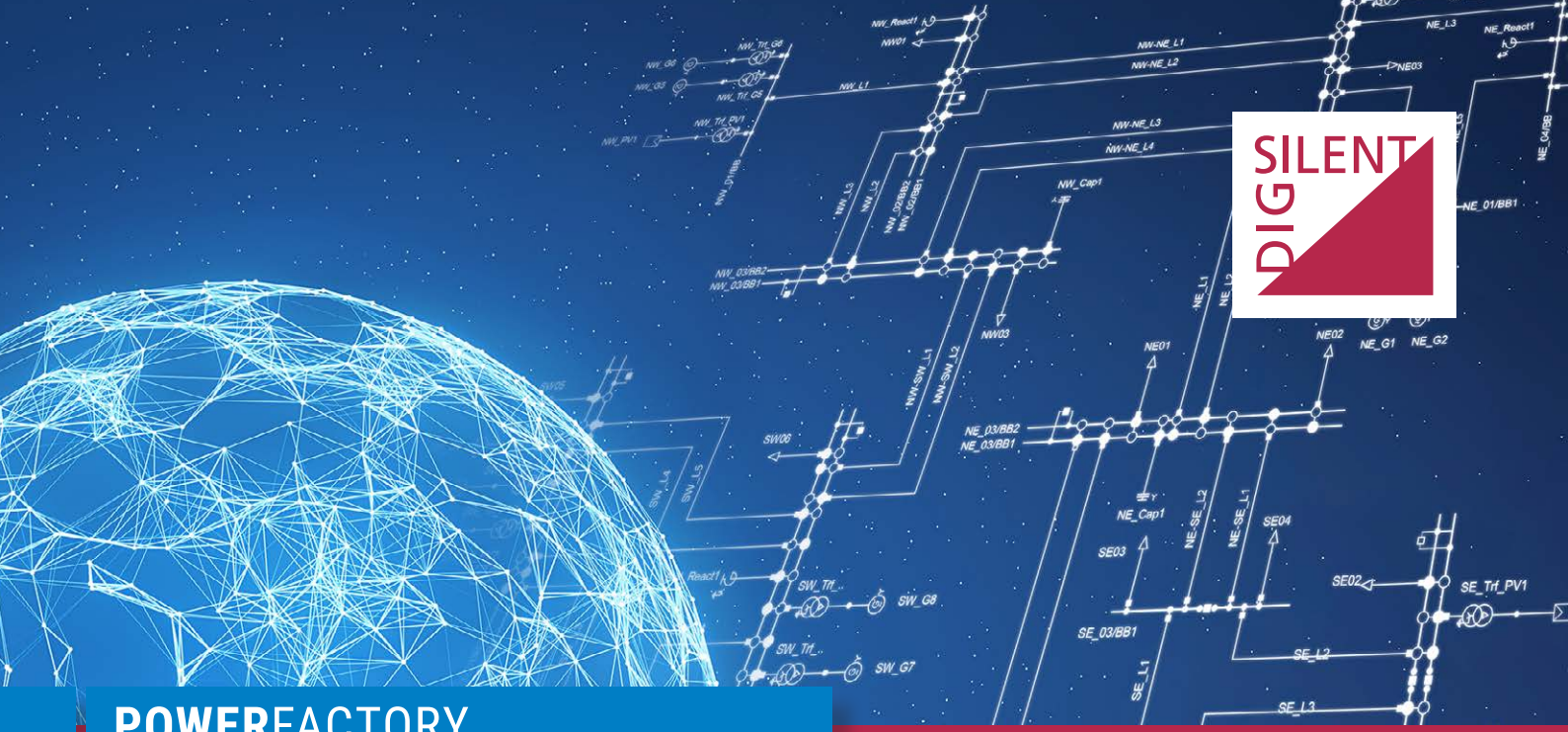

PowerFactory 2021

Technical Reference

ABB REM 610

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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November 15, 2019
PowerFactory 2021
Revision 924

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1 Model information

Manufacturer ABB

Model REM 610

Variants This PowerFactory relay model cover the features present in the ABB REM 610 motor protection relays up to Version H.

2 General description

REM610 is a versatile multifunction protection relay mainly designed for protection of standard medium and large MV asynchronous motors in a wide range of motor applications. It handles fault conditions during motor start up, normal run, idling and cooling down at standstill in, for example, pump, fan, mill or crusher applications.
The large number of integrated protection functions makes REM610 a complete protection against motor damage.

The PowerFactory ABB REM 610 relay model consists of a monolithic relay model which simulates most of the protective elements available in the relay.

The main relay model includes the measurement and acquisition elements, the thermal image element, the phase, ground and negative sequence overcurrent protection elements, the undercurrent protection element, the phase reversal protection element, the cumulative start-up time counter and the output logic.

The model implementation has been based on the information available in the motor protection relay manuals. [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 a block which simulates a 3 phase CT and by a block which simulates a single phase CT converting the earth current; the secondary currents are then measured by one element which models the digital sampling of the relay.

3.1.1 Available Units

- One 3 phase current transformer (”Ct-3P” block, pin 1-2-3-4-5-6 in the relay).
- One single phase current transformer (”Ct-3I0” block, pin 7-8 in the relay).
- One 3 phase measurement element (”Measure” block).

The following relay input signals are available and can be used in the trip block user configurable logic (”Trip Logic” block, see 3.3.2):

- *DI1*
- *DI2*
- *DI3*
- *DI4*
- *DI5*

3.1.2 Functionality

The ”Ct-3P” and the ”Ct-3I0” block represent 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 ”Measure” block measures the currents sampling the input waves at 20 samples/cycles. The RMS values are calculated with a rectangular integration over a full cycle.

3.1.3 Data input

The CT secondary rated current (1 or 5 A) value must be set in the ”Measure” block (*Nominal Current* setting).

If no core CT is available please select the 3 phases CT also in the ”Ct-3I0” slot: the earth current will be calculated assuming that an Holmgreen’s connection of the phases is used.

3.2 Protective elements

A set of thermal image, definite and inverse time overcurrent and undercurrent elements is modeling the relay protective functions.

3.2.1 Available Units

- One three-phase thermal image element(”T>” block).
- One three-phase non-directional definite time or I^2t =K overcurrent element (”Is>” block).
- One three-phase non-directional definite time overcurrent element (”I>>” and ”I>> Start value doubler” block).
- One three-phase under current element (”I<” block).
- One earth fault non-directional definite time element(”Io>” block).
- One negative sequence overcurrent element (”I2>”, and ”I2>block logic” block).
- One phase reversal element (”Phase reversal protection”, and ”Phase reversal I calc” block).
- One cumulative start-up time counter element (”Start Detector 150%”, ”Start detector 12%”, ”Start logic”, and ”Start up counter” block).
- One *breaker failure* element (”CBFP” and ”Min I” block).

3.2.2 Functionality

Overcurrent elements :

The thermal image element (”T>” block) supports the standard IEC 60255-8 characteristic.

The ”Is>” block supports both the start-up supervision based on definite-time overcurrent protection and the start-up supervision based on thermal stress calculation. The selection, made in the relay in the SGF3 switch, can be set in the model with the *Characteristic* setting.

The *Automatic doubling of the start value of stage I>>* is modeled. The feature can be enabled in the ”I>> Start value doubler” block in the *DIP Settings* tab page. Please notice that the Start up can be detected only running a simulation. For testing purpose please set equal to *on* the *ForceDoubling* DIP Switch in the ”I>> Start value doubler” block in the *DIP Settings* tab page.

The negative sequence overcurrent element (”I2>” block) is inhibited when one of the following conditions is verified:

- All phase currents fall below 12% of the FLC.
- One or several phase currents exceed the FLC of the motor fourfold.
- The phase reversal element has started.

The earth fault element(”Io>” block) can be inhibited when the one or several phase currents exceed the FLC of the motor. The following thresholds are available:

- 4 I_n (SGF4/1 = 1, SGF4/2 = 0).

- 6 I_n (SGF4/1 = 0, SGF4/2 = 1).
- 8 I_n (SGF4/1 = 1, SGF4/2 = 1).

The threshold selection is made inside the "I0> Block logic" block in the *DIP Settings* tab page.

Undercurrent element The "I<" block is inhibited when no phase current is greater than 12% I_n.

Loss of phase The phase reversal protection feature is based on the "Loss of phase detector" block which is set with a 75% current threshold and with a 200 ms fixed time delay. The "Loss of phase detector" input value is the ratio between the negative sequence current and the maximum phase current which is calculated by the "Phase reversal I calc" block.

Motor start up The start condition is detected by the "Start logic" block which get the trip signal of the "Start detector 12%" block, which operates as under current element with a 12% I_n, and the trip signal of the "Start Detector 150%" block which operates an overcurrent element with a 150% I_n current fixed threshold. The "Start detector 12%' block has a 60 ms reset delay. To declare a start condition both the "Start detector 12%" and the "Start Detector 150%" trip signals must be on. It means that a start condition is declared if the current values jump from a value smaller than the "Start detector 12%" block 12% I_n current threshold to a value greater than the "Start Detector 150%" block current threshold in less than 60 ms. The start signal is then passed to the "Start up counter" block. When the motor restart is inhibited, the output logic present by default in the "Output Logic" block activates the *SO1* relay output signal.

Breaker failure The breaker failure feature is modeled by the "CBFP" timer which activates the *yCBFP* signal, connected to the "Output Logic" block, when a least one phase current is still greater than 12% I_n and at least one protective element has been tripped for a time greater than the time set in the *CBFP Time Setting* setting. When a *Breaker failure* condition is detected the output logic present by default in the "Output Logic" block activates the *PO2* relay output signal.

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 and undercurrent elements :

Address	Relay Setting	Model block	Model setting	Note
	PU scale	T>	Current Setting (Ipsetr)	
	t_{6x}	T>	Time Dial (Tpset)	
	p	T>	Time Shift (Tshift)	
	Kc	T>	Reset Delay (ResetT)	Unit less multiplier
	I_s>/I_n	Is>	Pickup Current (Ipset)	
	t_s>	Is>	Time Dial (Tpset)	
	SGF3/6	Is>	Characteristic (pcharac)	To select the supervision mode
	SGF3/1	I>>	Out of Service (outserv)	

Address	Relay Setting	Model block	Model setting	Note
	I>>/I_n	I>>	Pickup Current (Ipset)	
	t>>/	I>>	Time Setting (Tset)	
	SGF3/8	I>> Start value doubler	SGF38	In the *DIP Settings* tab page
	SGF3/3	Io>	Out of Service (outserv)	
	I_0>/I_n	Io>	Pickup Current (Ipset)	
	t_0>	Io>	Time Setting (Tset)	
	SGF4/1	I0> Block logic	SGF41	In the *DIP Settings* tab page
	SGF4/2	I0> Block logic	SGF42	In the *DIP Settings* tab page
	SGF3/2	I<	Out of Service (outserv)	
	I</I_n	I<	Pickup Current (Ipset)	
	t<	I<	Time Setting (Tset)	
	SGF3/4	I2>	Out of Service (outserv)	
	I_2>/I_n	I2>	Current Setting (Ipsetr)	
	K_2	I2>	Time Dial (Tpset)	
	CBFP	CBFP	Time Setting (Tdelay)	

Phase reversal :

Address	Relay Setting	Model block	Model setting	Note
	SGF3/5	Phase reversal protection	Out of Service (outserv)	

Cumulative start-up time counter :

Address	Relay Setting	Model block	Model setting	Note
	$\Delta\Sigma t_s/\Delta t$	Start up counter	Reset Delay (ResetT)	
	Σt_{si}	Start up counter	Time Dial(Tpset)	

The trip of each protective element can activate the *Circuit-breaker failure protection* monitoring feature. The activation logic can be configured in the ”Logic” tab page of the ”Trip Logic” block where the *CBFP* variable is defined. By default the thermal image and the phase reversal element don’t activate the *Circuit-breaker failure protection* monitoring feature (see 3.3.2)

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 and Output signals

Units:

- One trip logic element ("Trip Logic" block).
- One breaker trip element ("Output Logic" block).

Output Signals

- *PO1*
- *PO2*
- *PO3*
- *SO1*
- *SO2*

3.3.2 Functionality

The "Output Logic" block collects the trip signals coming from the protective elements after that the trip logic present in the "Trip Logic" block has been applied and operates the "PO1", "PO2" and "PO3" relay output contacts. The *SO1* and the *SO2* signal cannot operate the breaker and can be used for signaling purposes.
The trip logic can be modified in the "Logic" tab page of the "Trip Logic" for instance combining together the trip signal of the protective elements and the digital inputs.
The assignation of the relay output contacts to the protective elements can be modified in the "Logic" tab page of the "Output Logic".

3.3.3 Data input

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

4 Features not supported

The following features are not supported:

- Alarm thermal stage.
- Trip-circuit supervision.
- RTD module features.

5 References

[1] ABB Oy Distribution Automation, P.O. box 699, FI-65101 Vaasa , FINLAND. *Motor Protection Relay REM610 Technical Reference Manual 1MRS752263-MUM Issued: 25.11.2003 Version: H/18.11.2011*, 2003.

[2] ABB Oy Distribution Automation, P.O. box 699, FI-65101 Vaasa , FINLAND. *Motor Protection Relay REM610 Technical Reference Manual - ANSI Version 1MRS755537 Issued: 11.04.2005 Version: E/18.11.2011*, 2011.