



ABB REM 543 PowerFactory Relay model description



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1 Model general description

The ABB REM 543 relay model consists of a main relay model and 7 subrelays:

- REM 543 overcurrent (F50/51)
- REM 543 voltage elements (F27/59)
- REM 543 frequency (F81)
- REM 543 power (F32)
- REM 543 differential (F87)
- REM 543 under impedance (F21)
- REM 543 under reactance (F40)

The main relay contains the measurement units, the output logic and all other subrelays.

Please notice that many protective elements can be used with the peak to peak RMS value (including all harmonics) or with the fundamental frequency RMS value. For such protective elements the REM 543 PF model contains two blocks: one is fed by the peak to peak RMS value, one by fundamental frequency RMS value. Please notice that only one of them can be enabled at the same time. The names of the blocks using the peak to peak RMS value contain the "ptop" suffix, the names of the fundamental frequency RMS value blocks contain the "fundf" suffix.

The following input elements are available in the main relay:

- ◆ Six current input blocks ("Ct", "Neutral Ct", "Local Ct (Diff)", "Remote Ct (Diff)", "Local Ct (High Z)" and "Remote Ct (High Z)" block)
 - ◆ One 3 phase CT ("Ct" block).
 - ◆ One 3 phase CT ("Local Ct (Diff)" block) located at the side of the power system zone protected by the differential elements where the REL 543 is.
 - ◆ One 3 phase CT ("Remote Ct (Diff)" block) located at the other side of the power system zone protected by the differential elements.
 - ◆ One 3 phase CT ("Local Ct (High Z)" block) located at the side of the power system zone protected by the high impedance differential elements where the REL 543 is.
 - ◆ One 3 phase CT ("Remote Ct (High Z)" block) located at the other side of the power system zone protected by the high impedance differential elements
 - ◆ One single phase CT ("Neutral Ct" block) located on the machine grounding wire.
- ◆ One voltage input blocks ("Vt" block)
 - ◆ One 3 phase VT ("Vt" block)

The following functionalities are modelled:

"ABB REM 543 overcurrent elements (F50/51)" subrelay:

- ◆ One 3 phase inverse time overcurrent elements (the "NOC3Low ptop" block using the peak to peak RMS current and the "NOC3Low fundf" block using the fundamental frequency RMS current)

- ◆ Two 3 phase definite time overcurrent elements (the "NOC3High ptop", the "NOC3Inst ptop" block using the peak to peak RMS current, the "NOC3High fundf", the "NOC3Inst fundf" block using the fundamental frequency RMS current)
- ◆ One 3 phase directional inverse time overcurrent elements (the "DOC3Low ptop" block using the peak to peak RMS current and the "DOC3Low fundf" block using the fundamental frequency RMS current). Each element can be configured with a different directional characteristic which can us the ph-ph or ph-grnd polarizing voltage (please notice that a different directional block is available for the blocks using the peak to peak RMS current and for the blocks the fundamental frequency). Four Directional blocks are available: "DOC6Low Ph-Phv Dir ptop", "DOC6Low Ph-Phv Dir fundf", "DOC6Low Ph-Ev Dir ptop" and "DOC6Low Ph-Ev Dir fundf".
- ◆ Two 3 phase directional definite time overcurrent elements (the "DOC3High ptop", the "DOC3Inst ptop" block using the peak to peak RMS current, the "DOC3High fundf", the "DOC3Inst fundf" block using fundamental frequency RMS current). Each element can be configured with a different directional characteristic which can us the ph-ph or ph-grnd polarizing voltage (please notice that a different directional block is available for the blocks using the peak to peak RMS current and for the blocks the fundamental frequency). Eight Directional blocks are available: "DOC6High Ph-Phv Dir ptop", "DOC6Inst Ph-Phv Dir ptop", "DOC6High Ph-Phv Dir fundf", "DOC6Inst Ph-Phv Dir fundf", "DOC6High Ph-Ev Dir ptop", "DOC6Inst Ph-Ev Dir ptop", "DOC6High Ph-Ev Dir fundf" and "DOC6Inst Ph-Ev Dir fundf".
- ◆ One ground current inverse time overcurrent elements (the "NEF1Low ptop" block using the peak to peak RMS current and the "NEF1Low fundf" block using the fundamental frequency RMS current)
- ◆ Two ground current definite time overcurrent elements (the "NEF1High ptop", the "NEF1Inst ptop" block using the peak to peak RMS current, the "NEF1High fundf", the "NEF1Inst fundf" block using the fundamental frequency RMS current)
- ◆ One ground current directional inverse time overcurrent elements (the "DEF1Low ptop" block using the peak to peak RMS current and the "DEF1Low fundf" block using the fundamental frequency RMS current). Each element can be configured with a different directional characteristic (please notice that a different directional block is available for the blocks using the peak to peak RMS current and for the blocks the fundamental frequency). Two Directional blocks are available ("DEF2Low ptop Dir" and "DEF2Low fundf Dir" block).
- ◆ Two ground current directional definite time overcurrent elements (the "DEF1High ptop", the "DEF1Inst ptop" block using the peak to peak RMS current, the "DEF1High fundf", the "DEF1Inst fundf" block using the fundamental frequency RMS current). Each element can be configured with a different directional characteristic (please notice that a different directional block is available for the blocks using the peak to peak RMS current and for the blocks the fundamental frequency). Four Directional blocks are available ("DEF2High ptop Dir" and "DEF2High fundf Dir" block, "DEF2Inst ptop Dir" and "DEF2Inst fundf Dir" block).
- ◆ One negative sequence current inverse time overcurrent element ("NPS3Low" block)
- ◆ One negative sequence current definite time overcurrent element ("NPS3High" block)
- ◆ Two phase undercurrent definite time elements (the "NUC3St1 ptop", the "NUC3St2 ptop" block using the peak to peak RMS current, the "NUC3St1 fundf", the "NUC3St2 fundf" block using the fundamental frequency RMS current)
- ◆ Thermal overload protection element ("TOL3Dev" block)
- ◆ Two phase overcurrent voltage restrained/controlled elements ("VOC6Low" and "VOC6High" block). To select which voltage logic is enabled, the restraint factor ("V Dep OC k Set" variable) and the restraint voltage levels ("V Dep OC V<1Set" and "V value derived from the phase voltages or the value measured by the open delta VT) is used can be set in the "logic" tab page of the "51V Restraint calc" block.

"ABB REM 543 voltage elements (F27/59" sub relay:

- ◆ Two zero sequence definite time overvoltage elements (the "ROV1Low ptop" and the "ROV1High ptop" block using the peak to peak RMS voltage, the "ROV1Low fundf" and the "ROV1High fundf" block using the fundamental frequency RMS voltage)
- ◆ One phase inverse time overvoltage elements (the "OV3Low Ph-Ph ptop" block using the phase-phase peak to peak RMS voltage, the "OV3Low Ph-Ph fundf" block using the phase-phase fundamental frequency RMS voltage, the "OV3Low Ph-E fundff" block using the phase-earth fundamental frequency RMS voltage)
- ◆ One phase definite time overvoltage elements (the "OV3High Ph-Ph ptop" block using the phase-phase peak to peak RMS voltage, the "OV3High Ph-Ph fundf" block using the phase-phase fundamental frequency RMS voltage, the "OV3High Ph-E fundff" block using the phase-earth fundamental frequency RMS voltage)
- ◆ One phase inverse time undervoltage elements (the "UV3Low Ph-Ph ptop" block using the phase-phase peak to peak RMS voltage, the "UV3Low Ph-Ph fundf" block using the phase-phase fundamental frequency RMS voltage, the "UV3Low Ph-E fundff" block using the phase-earth fundamental frequency RMS voltage)

- ◆ One phase definite time undervoltage elements (the "UV3High Ph-Ph ptop" block using the phase-phase peak to peak RMS voltage, the "UV3High Ph-Ph fundf" block using the phase-phase fundamental frequency RMS voltage, the "UV3High Ph-E fundff" block using the phase-earth fundamental frequency RMS voltage)
- ◆ Two positive sequence overvoltage time defined elements (the "PSV3St1 U1>" and the "PSV3St2 U1>" block)
- ◆ Two positive sequence undervoltage time defined elements (the "PSV3St1 U1<" and the "PSV3St2 U1<" block)
- ◆ Two negative sequence overvoltage time defined elements (the "PSV3St1 U2>" and the "PSV3St2 U2>" block)

ABB REM 543 frequency (F81) sub relay:

- ◆ Five over/under frequency elements with voltage restraint ("f>/f< 1", "f>/f< 2", "f>/f< 3", "f>/f< 4" and "f>/f< 5" block, for the voltage restraint: "Undervoltage Blocking 1", "Undervoltage Blocking 2", "Undervoltage Blocking 3", "Undervoltage Blocking 4" and "Undervoltage Blocking 5" block)
- ◆ Five rate of change of frequency elements with voltage restraint("df/dt>1", "df/dt>2", "df/dt>3", "df/dt>4" and "df/dt>5" block)
- ◆ Five logics which can be freely defined to combine each over/under frequency element with the relevant change of frequency element ("fdfdt1logic", "fdfdt2logic", "fdfdt3logic", "fdfdt4logic" and "fdfdt5logic" block)
- ◆ Four over fluxing elements ("V/Hz>1", "V/Hz>2", "V/Hz>3" and "V/Hz>4" block)

ABB REM 543 power (F32) sub relay:

- ◆ Three forward direction over power time defined elements using the ph-ph voltages ("OPOW6St1 ph-ph fwd", "OPOW6St2 ph-ph fwd", "OPOW6St3 ph-ph fwd" block)
- ◆ Three reverse direction over power time defined elements using the ph-ph voltages ("OPOW6St1 ph-ph rev", "OPOW6St2 ph-ph rev", "OPOW6St3 ph-ph rev" block)
- ◆ Three forward direction under power time defined elements using the ph-ph voltages ("UPOW6St1 ph-ph fwd", "UPOW6St2 ph-ph fwd", "UPOW6St3 ph-ph fwd" block)
- ◆ Three reverse direction under power time defined elements using the ph-ph voltages ("UPOW6St1 ph-ph rev", "UPOW6St2 ph-ph rev", "UPOW6St3 ph-ph rev" block)
- ◆ Three forward direction over power time defined elements using the ph-e voltages ("OPOW6St1 ph-e fwd", "OPOW6St2 ph-e fwd", "OPOW6St3 ph-e fwd" block)
- ◆ Three reverse direction over power time defined elements using the ph-e voltages ("OPOW6St1 ph-e rev", "OPOW6St2 ph-e rev", "OPOW6St3 ph-e rev" block)
- ◆ Three forward direction under power time defined elements using the ph-e voltages ("UPOW6St1 ph-e fwd", "UPOW6St2 ph-e fwd", "UPOW6St3 ph-e fwd" block)
- ◆ Three reverse direction under power time defined elements using the ph-e voltages ("UPOW6St1 ph-e rev", "UPOW6St2 ph-e rev", "UPOW6St3 ph-e rev" block)

Please note that only six of these blocks can be active at the time; indeed the relay has only three over power stages and three underpower stages; each of them can be configured to work in the forward or in the reverse direction, to use the ph-ph or the ph-grnd voltages.

ABB REM 543 differential and REF:

- ◆ One transformer differential element ("Diff6G" block). The element has a current restraint threshold and an unrestraint threshold
- ◆ One high impedance or flux based differential element ("Diff3" block). Please insert the stabilizing resistor value inside the connected Ct dialog in the "Sec. Winding Resistance" field in the "Additional data" tab page.
- ◆ One high impedance based restricted earth fault protection ("REF1A" block). Please insert the stabilizing resistor value inside the connected Ct dialog in the "Sec. Winding Resistance" field in the "Additional data" tab page.

ABB REM 543 underimpedance elements sub relay:

- ◆ Two under reactance elements are present in the relay. In the PF model four different versions of each element, one for each type of polarizing voltage, are available but only two of them can be enabled at the same time ("UI6Low 3ph ph-ph ptop", "UI6Low 3ph ph-ph ptop", "UI6Low 3ph ph-ph fundf", "UI6Low 3ph ph-ph fundf", "UI6High 3ph ph-ph ptop", "UI6High 3ph ph-ph ptop", "UI6High 3ph ph-ph fundf", "UI6High 3ph ph-ph fundf")

ptop", "UI6High 3ph ph-e ptop", "UI6High 3ph ph-ph fundf", "UI6High 3ph ph-e fundf", block). Please notice that in the model the rated impedance value must be used to calculate the "Replica impedance" and the "offset impedance" model settings and inserted in secondary Ohm instead of p.u. ("UN/IN")

- ◆ Two timers ("UI6Low Timer" and "UI6High Timer" block)

ABB REM 543 undereactance elements sub relay:

- ◆ Two under reactance elements are present in the relay. In the PF model six different versions of each element, one for each type of polarizing voltage, are available but only two of them should be enabled at the same time ("UE6Low 3ph ph-ph pos seq", "UE6Low 3ph ph-e pos seq", "UE6Low 3ph ph-ph fundf", "UE6Low 3ph ph-e fundf", "UE6Low 1ph ph-ph fundf", "UE6Low 1ph ph-e fundf", "UE6High 3ph ph-ph pos seq", "UE6High 3ph ph-e pos seq", "UE6High 3ph ph-ph fundf", "UE6High 3ph ph-e fundf", "UE6High 1ph ph-ph fundf" and "UE6High 1ph ph-e fundf" block). Please notice that in the model the rated impedance value must be used to calculate the "Replica impedance" and the "offset impedance" model settings and inserted in secondary Ohm instead of p.u. ("UN/IN")
- ◆ Two timers ("UE6Low Timer" and "UE6High Timer" block)

2 Relay not supported features

The following features are not supported:

- Positive and negative sequence voltage element combined logics
- Phase reversal protection
- Startup supervision
- Phase reversal protection
- Synchro-check
- Transformer inrush and motor startup current detector
- Fuse failure supervision

3 References

The model implementation has been based on the information available in the "Machine terminal REM543 REM 545 Product guide 1MRS751173-MBG Version: F/22.05.2006" document.