PowerFactory 2021

Technical Reference

ABB SACE TMAX T1-T7

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Contents

1   Model information

Manufacturer   ABB SACE

Model   TMAX T1-T7

Variants   These PowerFactory relay model types simulate the different firmware and hardware versions of the ABB SACE TMAX T1-T7 Low Voltage breakers.

2   General description

The ABB SACE TMAX is a family of moulded-case circuit-breakers with advanced performance/size ratio. Different models are available for rated current from 16 to 1600 A.

The simplest ABB SACE TMAX T1-T7 LVBRs like the T1, T2 and T3 are protection assemblies containing a phase over current thermic element, and a magnetic instantaneous element. T4, T5, and T6 can be also be equipped with the PR221, PR222, and PR223 electronic trip units. Tmax T7 can also mount the latest generation PR231, PR232, PR331 and PR332 electronic trip units.

The ABB SACE TMAX T1-T7 LVBRs have been modeled using the following 44 PowerFactory relay models which include most of the features available in this family of low voltage breakers:

- SACE Tmax T1

    - SACE Tmax T1 TMD 16-50A 500A
    - SACE Tmax T1 TMD 16-63A 630A
    - SACE Tmax T1 TMD 160A
    - SACE Tmax T1 TMD 80-125A

- SACE Tmax T2

    - SACE Tmax T2 PR221DS
    - SACE Tmax T2 TMD 1.6-100A
    - SACE Tmax T2 TMD 125A
    - SACE Tmax T2 TMD 160A
    - SACE Tmax T2 TMG 160A

- SACE Tmax T3

    - SACE Tmax T3 TMD 125A & 250A
    - SACE Tmax T3 TMD 160A & 200A
    - SACE Tmax T3 TMD 63-100A
    - SACE Tmax T3 TMG 63-250A

- SACE Tmax T4

    - SACE Tmax T4 PR221DS
    - SACE Tmax T4 PR221DS 320A

- **–** SACE Tmax T4 PR222
- **–** SACE Tmax T4 PR222 320A
- **–** SACE Tmax T4 PR223
- **–** SACE Tmax T4 PR223 320A
- **–** SACE Tmax T4 TMA 125A & 250A
- **–** SACE Tmax T4 TMA 160A & 200A
- **–** SACE Tmax T4 TMA 80-100A
- **–** SACE Tmax T4 TMD 20-50A

- • SACE Tmax T5

  - **–** SACE Tmax T5 PR221DS
  - **–** SACE Tmax T5 PR221DS 630A
  - **–** SACE Tmax T5 PR222
  - **–** SACE Tmax T5 PR222 630A
  - **–** SACE Tmax T5 PR223
  - **–** SACE Tmax T5 PR223 630A
  - **–** SACE Tmax T5 TMA 320-400A
  - **–** SACE Tmax T5 TMA 500A
  - **–** SACE Tmax T5 TMG 320-500A

- • SACE Tmax T6

  - **–** SACE Tmax T6 PR221DS
  - **–** SACE Tmax T6 PR221DS 1000A
  - **–** SACE Tmax T6 PR222 1000A
  - **–** SACE Tmax T6 PR222 630A
  - **–** SACE Tmax T6 PR222 800A
  - **–** SACE Tmax T6 PR223 1000A
  - **–** SACE Tmax T6 PR223 630A
  - **–** SACE Tmax T6 PR223 800A
  - **–** SACE Tmax T6 TMA 630A
  - **–** SACE Tmax T6 TMA 800A

- • SACE Tmax T7

  - **–** SACE Tmax T7 PR23x
  - **–** SACE Tmax T7 PR33x

The model implementation has been based on the information available in the low voltage breaker documentation provided by the manufacturer and freely available [1].

For more information regarding the *SACE Tmax T7 PR23x* and the *SACE Tmax T7 PR33x* please refer to specific technical references.

3 Supported features

3.1 Measurement and acquisition & input signals

It represents the interface between the power system and the Low Voltage Breaker 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 single phase neutral CT; the secondary currents are then measured by a three phase and neutral measurement element which models the data acquisition of the relay. If a ground overcurrent element is available, like in PR222 and in the PR223 electronic trip units, a separated measurement element ("Neutral Measure" block) process the neutral current.

3.1.1 Available Units

- one 3 phase current transformer ("Ct" block).

- one single phase current transformer ("Neutral Ct" block).

- one 3 phase measurement element ("Measure" block).

- one single phase measurement element ("Neutral Measure" block only in the *PR222* and in the *PR223* trip unit).

3.1.2 Functionality

The "Ct" and the "Neutral Ct" blocks represent 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.

3.1.3 Data input

The ratio of the "Ct" must be 1/1.

The Low Voltage Breaker primary rated current value must be set in the current measurement element ("Measure" block and "Neutral Measure" block (only in the *PR222* and in the *PR223*),*"Nominal current"* parameter). The following values are available:

SACE Tmax T1 TMD 1-50A 500A   :

• 16	• 25	• 40
• 20	• 32	• 50

SACE Tmax T1 TMD 1-63A 630A   :

- 16
- 20
- 25
- 32
- 40
- 50
- 63

SACE Tmax T1 TMD 160A   :

- 160

SACE Tmax T1 TMD 80-125A   :

- 80
- 100
- 125

SACE Tmax T2 TMD 1.6-100A   :

- 1.6
- 2
- 2.5
- 3.2
- 4
- 5
- 6.3
- 8
- 10
- 12.5
- 16
- 20
- 25
- 32
- 40
- 50
- 63
- 80
- 100

SACE Tmax T2 TMD 125A   :

- 125

SACE Tmax T2 TMD 160A   :

- 160

SACE Tmax T2 TMG 160A   :

- 10
- 25
- 63
- 100
- 160

SACE Tmax T3 TMD 125A & 250A   :

- 125
- 250

SACE Tmax T3 TMD 160A & 200A   :

- 160
- 200

SACE Tmax T3 TMD 63-100A   :

- 63
- 80
- 100

SACE Tmax T3 TMG 63-250A   :

- 63
- 80
- 100
- 125
- 160
- 200
- 250

SACE Tmax T4 TMA 125A & 250A   :

- 125
- 250

SACE Tmax T4 TMA 160A & 200A   :

- 160
- 200

SACE Tmax T4 TMA 80-100A   :

- 80
- 100

SACE Tmax T4 TMD 20-50A   :

- 20
- 32
- 50

SACE Tmax T5 TMA 320-400A   :

- 320
- 400

SACE Tmax T5 TMA 500A   :

- 320
- 400
- 500

SACE Tmax T5 TMG 320-500A   :

- 320   • 400   • 500

SACE Tmax T6 TMA 630   :

- 630

SACE Tmax T6 TMA 800

- 800

3.2   Protective elements

When the assembly contains an electromagnetic unit, the model consists of an inverse time and a definite time 3 phase overcurrent element. Two single phase elements, identical to the 3 phase elements, model the neutral current monitoring available in the 4 wires versions of the Tmax LVBRs family.
When an electronic trip unit is present, the model consists of one long time (inverse time), one short time (inverse or time defined), and one instantaneous element. Also in this case a set of single phase elements identical to the 3 phase elements protect the neutral conductor. The "PR222" and the "PR223" trip unit contain also a ground current inverse time overcurrent element.

3.2.1   Available Units

- one 3 phase inverse time overcurrent element ("L" block).

- one 3 phase definite/inverse time overcurrent element ("S" block) only in the electronic trip units.

- one 3 phase definite time overcurrent element ("I" block).

- one single phase inverse time ground overcurrent element ("G" block).

- one single phase inverse time neutral overcurrent element ("NL" block).

- one single phase definite/inverse time neutral overcurrent element ("NS" block) only in the electronic trip unit.

- one single phase definite time neutral overcurrent element ("NI" block).

3.2.2   Functionality

All the inverse characteristics available in the Low voltage breaker are supported by the inverse time overcurrent element.
The thermo magnetic characteristics have been digitized and the relevant point sets inserted in the PowerFactory database. Different digitized curves are available for the *minimum trip* characteristic (minimum time required to detect and remove the fault) and the *max clear* characteristic (maximum time required to remove the fault). Additionally, due to the thermal characteristic of the element two set of curves are available. The user must select in the "L" dialog if the *Hot* or

the *Cold* trip characteristics should be used. The *Cold* trip characteristic is intended to be used when the thermal effects of the current disappeared, the *Hot* trip characteristic represents the trip times when the prefault current is equal to the device rated current. The active trip characteristic must be manually selected by the user.

The trip equations available in the electronic trip units documentation have been inserted in the models including the trip tolerance.

The following tolerances are used in the ABB SACE TMAX T1-T7 model with thermo magnetic unit:

L Tolerance depending up on the digitized curves.

I Trip Threshold tolerance ±20%, Trip Time tolerance 40 ms.

The following tolerances are used in the ABB SACE TMAX T1-T7 model when an electronic trip unit is use:

L Trip Threshold between 105% and 120% of the threshold, Trip Time tolerance ±10%.

S *S-Curve* trip curve: Trip Threshold tolerance ±10% I1, Trip Time tolerance ±10%.

I Trip Threshold tolerance ±20%. Max trip time tolerance 0.04 s.

G Trip Threshold tolerance ±10% I1, Trip Time tolerance ±15%.

3.2.3 Data input

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

Address	Relay Setting	Model block	Model Parameter	Note
	Thermal Trip Threshold	L	Current Setting (Ipset)	
		NL	Current Setting (Ipset)	
	Thermal Trip Time	L	Time Dial (Tpset)	
		NL	Time Dial (Tpset)	
	Magnetic Disabling	I	Out of Service (outserv)	
		NI	Out of Service (outserv)	
	Magnetic Trip Threshold	I	Current Setting (Ipset)	
		NI	Current Setting (Ipset)	
	L Trip Threshold	L	Current Setting (Ipset)	
		NL	Current Setting (Ipset)	
	L Trip Curves	L	Characteristic (pcharac)	
		NL	Characteristic (pcharac)	
	L Trip Time	L	Time Dial (Tpset)	
		NL	Time Dial (Tpset)	
	S Trip Threshold	S	Current Setting (Ipset)	

Address	Relay Setting	Model block	Model Parameter	Note
		NS	Current Setting (Ipset)	
	S Trip Curves ($I^2t = const$ or $t = const$)	S	Characteristic (pcharac)	
		NS	Characteristic (pcharac)	
	S Trip Time	S	Time Dial (Tpset)	
		NS	Time Dial (Tpset)	
	I Trip Threshold	I	Pickup Current (Ipset)	
		NI	Pickup Current (Ipset)	
	G Trip Threshold	G	Current Setting (Ipset)	
	G Trip Time	G	Time Dial (Tpset)	

No user input is required in the neutral overcurrent elements which must manually disabled by the user if the LVBR version is a 3 wires LVBR.

3.3   Output logic

It represents the output stage of the low voltage breaker.

3.3.1   Available Units

- one output element ("Logic" block).

- one output signal ("yout" signal)

3.3.2   Functionality

The "Logic" block collects the trip signals coming from the protective functions; it operates the low voltage breaker power contact using the "yout" trip signal.

3.3.3   Data input

To disable completely the low voltage breaker model ability to open the power circuit disable the "Logic" block.

4   References

[1] ABB SACE S.p.A., Divisione Interruttori B.T., Via Baioni, 35 - 24123 Bergamo - Italy. *Tmax. T Generation Low voltage moulded-case circuit-breakers up to 1600 A Technical catalogue 1SDC210015D0202*.