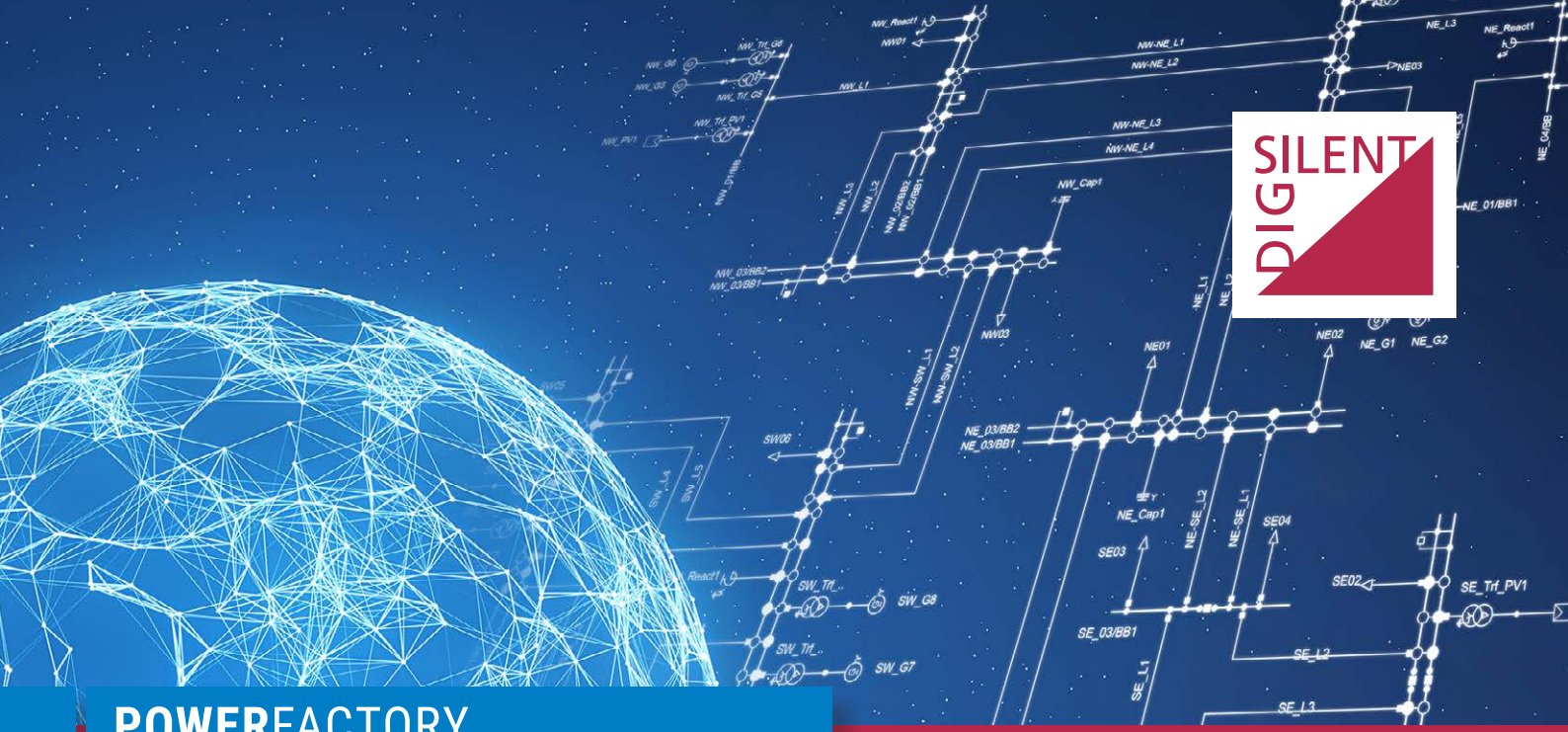

POWERFACTORY

# PowerFactory 2021

## Technical Reference

### ABB SACE EMAX PR122

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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# Contents

# 1 Model information

**Manufacturer** ABB SACE

**Model** EMAX PR122

**Variants** This PowerFactory relay model type simulates the different firmware versions of the ABB SACE EMAX PR122 Low Voltage breakers.

# 2 General description

The ABB SACE EMAX PR122 is a microprocessor air circuit breakers up to 6300A which have been designed to increase efficiency. Accordingly to the manufacturer brochures it is the only breaker that protects electrical circuits and also reduces energy consumption based on the user's needs, therefore leading to massive reductions in energy waste.

The ABB SACE EMAX PR122 is a protection assembly containing a phase over current long time element, a short time element and an instantaneous element. A Definite time ground overcurrent element with an activable I2t feature is also available. The additional PR120/V module provide four voltage elements.

The ABB SACE EMAX PR122 Low Voltage Breaker has been modeled using one PowerFactory relay model which includes most of the features available in the Low Voltage Breaker.

The model implementation has been based on the information available in the low voltage breaker documentation provided by the manufacturer and freely available [1] [2].

# 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 , the voltages by an element simulating a 3 phase VT; the secondary voltages and currents are then measured by three measurement elements which models the digital filter of the relay.

### 3.1.1 Available Units

- one 3 phase current transformer (”Ct” block).
- one 3 phase voltage transformer (”Vt” block).
- one 3 phase measurement element (”Measure” block).
- one 3 phase sequence measurement element (”Measure Sequence” block).

- one frequency measurement element (”Meas Freq” block).
- two input signal (”block” and ’block1” input signal).

### 3.1.2 Functionality

The ”Ct” block represents 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 ”Measure” and the ”Measure Sequence” block calculate the RMS value of the current and voltage values sampling the input channels at 24 samples/cycle and calculating a rectangular integral.
The ”’Measure Sequence” block calculates the voltage zero sequence and negative sequence component RMS values.

The input signals can be used to block the ”G” element (”block” input signal) and the ”S” element (”block1” input signal) to implement *Zone selectivity* logics.

### 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,*”Nominal current”* parameter). The following values are available:

- 800
- 1000
- 1250
- 1600
- 2000
- 2500
- 3200
- 4000
- 5000
- 6300

The Low Voltage Breaker primary rated voltage must be inserted both in the ”Measure” block and in the ”Measure Sequence” block (*”Nominal Voltage”* parameter). The following values are available:

- 380
- 400
- 690

The ”Vt” secondary side rated voltage must be equal to the value inserted in the ”Nominal Voltage” of the measurement blocks.

## 3.2 Protective elements

A set of inverse time and a definite time overcurrent elements, four definite time voltage and two definite time frequency elements models the low voltage breaker protective functions.

### 3.2.1 Available Units

- one 3 phase inverse time overcurrent element (”L” block).
- one 3 phase inverse/definite time overcurrent element (”S” block).
- one 3 phase definite time overcurrent element (”I” block).
- one ground definite time overcurrent element with I2t feature (”G” block).
- one 3 phase definite time overvoltage element (”OV” block).
- one 3 phase definite time underervoltage element (”UV” block).
- one negative sequence definite time overvoltage element (”U” block).
- one definite time residual overvoltage element (”RV” block).
- one definite overfrequency element (”OF” block).
- one definite underfrequency element (”UF” block).

### 3.2.2 Functionality

All the inverse characteristics available in the relay are supported by the inverse time overcurrent element. In such trip characteristics the relationship between current and time complies with the IEC 60255-3 standard.
The following trip characteristics are modeled:

**L**

- IEC 60255-3 (type A)
- IEC 60255-3 (type B)
- IEC 60255-3 (type C)
- L-Curve

The *L-Curve* equation is $t = 9t_p/(I/I_p)^2$ where $T_p$ is the Trip Time and $I_p$ is the Trip Threshold

**S**

- S const
- S-I2t

The *S const* characteristic model the definite time trip curve of the *S* element, the *S-I2t* characteristic the definite time trip curve when the I2t feature has been enabled.

**G**

- G-const
- G-I2t

The *G-const* characteristic model the definite time trip curve of the *G* element, the *G-I2t* characteristic the definite time trip curve when the I2t feature has been enabled.

The following tolerances are used in the ABB SACE EMAX PR122 model:

**L** Trip Threshold tolerance 105%-120% I1, Trip Time tolerance $\pm$10%.

**S** *S const* trip curve: Trip Threshold tolerance $\pm$7% I1, Trip Time tolerance $\pm$10%.
*S-I2t* trip curve: Trip Threshold tolerance $\pm$7% I1, Trip Time tolerance -15% + 10%.

**I** Trip Threshold tolerance $\pm$10%

**G** *G-const* trip curve: Trip Threshold tolerance $\pm$7% I1, Trip Time tolerance $\pm$10%.
*S-I2t* trip curve: Trip Threshold tolerance $\pm$7% I1, Trip Time tolerance -15% + 10%.

**UV & OV** Trip Threshold tolerance 10% Trip Time tolerance 0.04 s.

**RV** Trip Threshold tolerance 10% Trip Time tolerance 0.04 s.

**OF & UF** Trip Threshold tolerance $\pm$5% Trip Time tolerance 0.04 s.

### 3.2.3 Data input

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

| Address | Relay Setting | Model block | Model Parameter | Note |
|---|---|---|---|---|
| | L Trip Threshold | L | Current Setting (Ipset) | |
| | L Trip Time | L | Time Dial (Tpset) | |
| | L (t=k/i2) curve or IEC 60255-3 | L | Characteristic (pcharac) | |
| | S Disabling | S | Out of Service (outserv) | |
| | S Trip Threshold | S | Current Setting (Ipset) | |
| | S Trip Time | S | Time Dial (Tpset) | |
| | S (t=k/i2) or (t=k) | S | Characteristic (pcharac) | |
| | I Disabling | I | Out of Service (outserv) | |
| | I Trip Threshold | I | Current Setting (Ipset) | |
| | U Disabling | U | Out of Service (outserv) | |
| | U Trip Threshold | U | Input Setting (Ipset) | |
| | U Trip Time | U | Time Dial (Tpset) | |

| Address | Relay Setting | Model block | Model Parameter | Note |
|---|---|---|---|---|
| | UV Disabling | UV | Out of Service (outserv) | |
| | UV Trip Threshold | UV | Input Setting (Ipset) | |
| | UV Time | UV | Time Dial (Tpset) | |
| | OV Disabling | OV | Out of Service (outserv) | |
| | OV Trip Threshold | OV | Input Setting (Ipset) | |
| | OV Time | OV | Time Dial (Tpset) | |
| | RV Disabling | RV | Out of Service (outserv) | |
| | RV Trip Threshold | RV | Input Setting (Ipset) | |
| | RV Time | RV | Time Dial (Tpset) | |
| | U F Disabling | UF | Out of Service (outserv) | |
| | U F Trip Threshold | UF | Input Setting (Ipset) | |
| | U F Time | UF | Time Dial (Tpset) | |
| | O F Disabling | OF | Out of Service (outserv) | |
| | O F Trip Threshold | OF | Input Setting (Ipset) | |
| | O F Time | OF | Time Dial (Tpset) | |
| | Warning current Iw Disabling | Warning current Iw | Out of Service (outserv) | |
| | Warning current Iw | Warning current Iw | Current Setting (Ipset) | |
| | Threshold LC1 Disabling | Threshold LC1 | Out of Service (outserv) | |
| | Threshold LC1 | Threshold LC1 | Current Setting (Ipset) | |
| | Threshold LC2 Disabling | Threshold LC2 | Out of Service (outserv) | |
| | Threshold LC2 | Threshold LC2 | Current Setting (Ipset) | |

## 3.3 Output logic

It represents the output stage of the low voltage breaker.

### 3.3.1 Available Units

- one output element (”Output Logic” block).
- foor output signals (”yout”, ”PR120K1”, ”PR120K2”, ”PR120K3”, and ”PR120K4” signal)

### 3.3.2 Functionality

The ”Output Logic” block collects the trip signals coming from the protective functions; it operates the low voltage breaker power contact using the ”yout” trip signal. It provides four additional output signals which can be used to implement a *Load Control* logic.

### 3.3.3 Data input

To disable completely the low voltage breaker model ability to open the power circuit disable the ”Output Logic” block. The *Load Control* logic (implemented by the PR120/K in the ABB SACE EMAX PR122 Low Voltage Breaker) can be modified in the ”Logic” tab page of the ”Output Logic” block. By default the ”PR120K1” output signal when any phase current is greater than the ”Warning current Iw” or the ”Threshold LC1” or the ”Threshold LC2” trip threshold.

# 4 References

[1] ABB SACE S.p.A., Divisione Interruttori B.T., Via Baioni, 35 - 24123 Bergamo - Italy. *Installation, service and maintenance instructions for low voltage air circuit-breakers EMAX 1SDH000460R0002 L2778*.

[2] ABB SACE S.p.A., Divisione Interruttori B.T., Via Baioni, 35 - 24123 Bergamo - Italy. *Technical catalogue Emax Low voltage air circuit-breakers 1SDC200006D0207 - 03/2010 - 6.000 - CAL*, 2010.