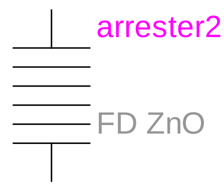
IEEE Frequency Dependent surge arrester



Henry Gras, 6/2/2023 3:25 PM

1 Description

This device accepts both 1-phase and 3-phase signals. It models ZnO surge arresters in two ways:

- Using a model based on **the IEEE Surge Protective Device Working Group 3.4.11** (see [1]) build with a RLC circuit and two piecewise exponential resistance. This model is suitable for high frequency analyses such as switching and lightning and is based on the circuit of Figure 1.

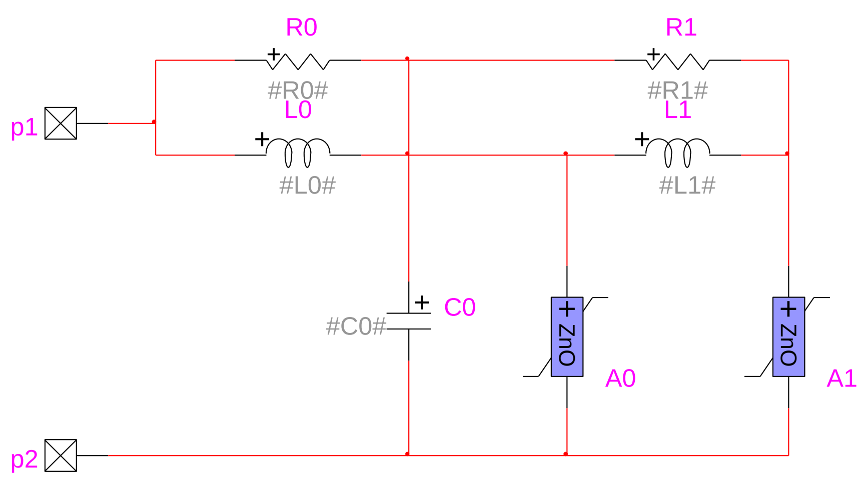


Figure 1: Frequency Dependent arrester model subcircuit.

The RLC parameters are calculated according to [1] using the surge arrester number of columns and their length. A0 and A1 are piecewise exponential resistance with voltage-current curve pre-defined in [1] and which are adjusted to match the switching and lightning impulse test results provided by users.
Once the device parameters are populated, several simulations are automatically started in order to perform the parameter fitting process. It may take several minutes and the progress may be followed in the consol.

- Using a **piecewise exponential resistance**. This model is simpler and provides acceptable results for switching and low frequency analyses. The fitting process is much faster as it only uses ZnO Data functions provided in the nonlinear library and no simulations are started.

Because of the use of ZnO Data function in both models, this device cannot be scripted.

2 Parameters

The parameters are:

- **Model**: Frequency Dependent: IEEE Working Group 3.4.44
- **MCOV**: Maximum Continuous Operating Voltage, in RMS phase-to-ground. See standard definition in [2]. Only used for the piecewise exponential resistance model.

2.1 Parameters for IEEE Surge Protective Device Working Group 3.4.11 models

The parameters are:

- **Number of columns of surge arrester in parallel**
- **Length of the surge arrester**
- **Maximum discharge current during the switching impulse test (see 3.1.38 in** [2])
- **Peak discharge voltage for switching**
- **Peak discharge voltage for lightning**
  The impulse has the following equation:
  $$i(t) = I_m\left[e^{\alpha t} - e^{\beta t}\right]$$
- **α of the surge current equation for switching discharge test**
- **β of the surge current equation for switching discharge**
- **Maximum discharge current during the lightning impulse test (see** [2])
- **Convergence precision**: Convergence criterion of the discharge test fitting. This criterion applies to the difference between the voltages obtained by simulations of the discharge tests and the measurements made during these tests which are entered by users as parameters.

3 References

[1] Modeling of metal oxide surge arresters, IEEE Working group 3.4.11, Application of surge protective devices subcommittee, surge protective device committee, transactions on Power Delivery, Vol. 7 No. 1, January 1992.

[2] IEEE C62.22-2009 Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems, IEEE Power & Energy Society, March 2009