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MODELING OPERATING MODES OF ONE-PHASE TRANSFORMER WITH THE SUPPLY OF "MATLAB" PROGRAM

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ABSTRACT

The article discusses the modeling of different modes of single-phase transformers using Matlab's Sim Power System package. Time-dependent graphs of currents and voltages are plotted for different modes.

KEYWORDS: *Model, Mousselization, Single-Phase Transformer, Short-Circuit Mode, Salt Operation Mode.*

INTRODUCTION

Given that students are not allowed to work directly with high voltage during the training process, they should use special software to develop skills about the operating modes of high voltage electrical equipment. High results can be achieved by modeling the single-phase and short-circuit modes of single-phase transformers used in the railway power supply system using the Matlab program's SimPowerSystem package.

Transformers are electrical devices that convert alternating current from one rated voltage to another rated voltage. The Linear Transformer block in Matlab's SimPowerSystem package is used to model a single-phase transformer. This block can be used to create models of single-phase two- and three-phase transformers. The following figure shows the electromagnetic circuit of this transformer (Figure 1).

The working window of the Linear Transformer block consists of the following parts:

Units - parameters can be expressed in units of measurement, international unit (SI) or relative unit (PU);

Nominal power and frequency [Pn (VA) fn (Hz)] - nominal total power and frequency;

Winding 1 parameters [V1 (Vrms) R1 (pu) L1 (pu)] - parameters of the first winding, ie winding voltage (V), active resistance (n.b.) and scattering inductance (n.b.), respectively;

Winding 3 parameters [V3 (Vrms) R3 (pu) L3 (pu)] - parameters of the third winding, ie winding voltage (V), active resistance (n.b.) and scattering inductance (n.b.), respectively;

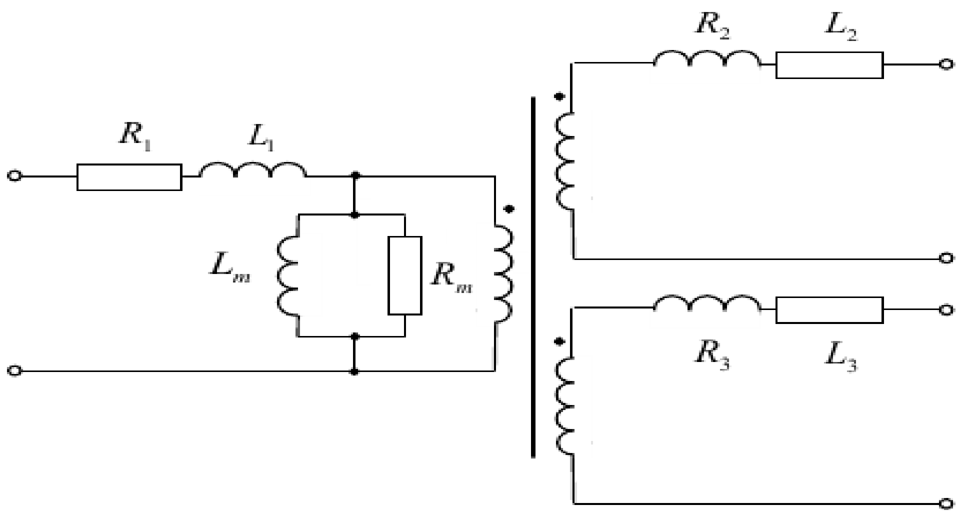

Figure 1

Magnetization resistance and inductance [Rm (pu) Lm (pu)] is the active resistance and mutual inductance of the magnetizing core, respectively;

Winding 2 parameters [V2 (Vrms) R2 (pu) L2 (pu)] - parameters of the second winding, ie winding voltage (V), active resistance (n.b.) and scattering inductance (n.b.), respectively;

Three windings transformer - three-winding transformer if the sign is installed, two-winding transformer if not installed;

Winding voltages - the voltage of the windings;

Winding currents;

Magnetization current - magnetization current;

All voltages and currents are all voltages and currents.

During the training, each student or 2-5 students will be provided with technical data of transformers used in the railway power supply system from reference books. Using the nominal parameters of the transformer, the parameters required for the Linear Transformer block are determined.

A new SimPowerSystems work window will be created, which will include Scope from Simulink (Commonly Used Blocks); Mux; Gain; (Sinks) Display; (Math Operations) Real-Imag to Complex; Abs; (Sources) Step, AC Voltage source in Specialized Technology block (Electrical Sources) from SimPowerSystems; (Measurements) Voltage Measurement; Current Measurement; (Control and Measurements Library Measurements) Power; RMS; (Elements) Breaker, Linear Transformer, Three-Phase Series RLC Branch elements are placed.

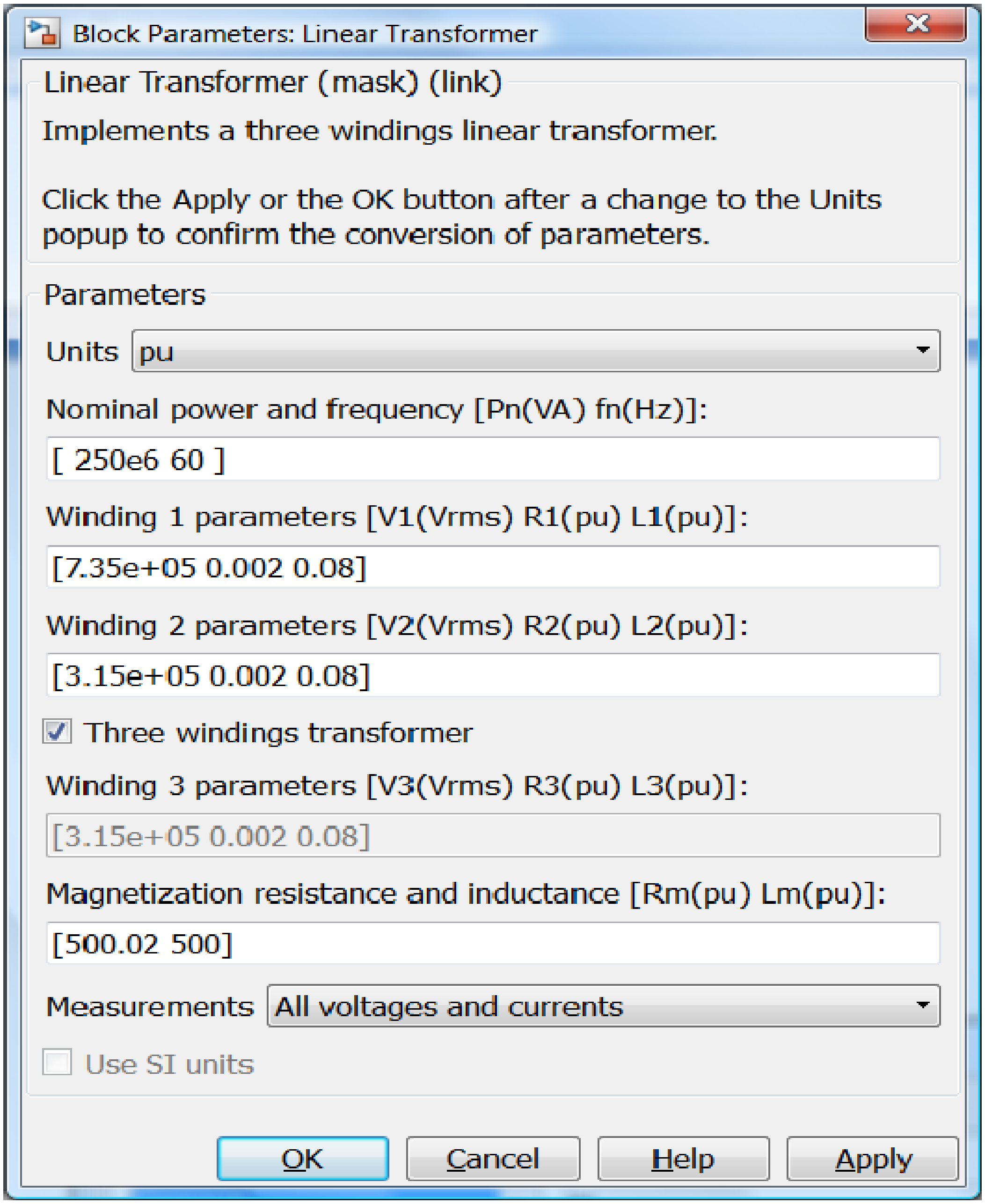

Figure 2. The working window of the Linear Transformer block

Once the blocks are placed in the working window of the model, the frequency of 60 Gs in the Power and RMS blocks is changed to 50 Gs. The input of the Scope block should be 2, and the Gain block should be numbered 3 for three-phase power. Once the changes have been made, a copy of the required blocks will be made.

The calculation time is set to 0.12 seconds. To do this, the desired working window is created from the Simulation → Model Configuration Parameters sequence and the Step time is set to 0.02 s.

Since a single phase of a three-phase transformer is considered, the amplitude value of the phase voltage must be entered. You need to set the inf for Resistance (Ohms) so that you can test the model in salt mode (Figure 3).

To test the short-circuit mode, the load resistance is reduced to 1e-12 Ohm, the step time is assumed to be 0.02 s, and the voltage is reduced to the voltage at which short-circuits can occur, i.e., 1e-8.

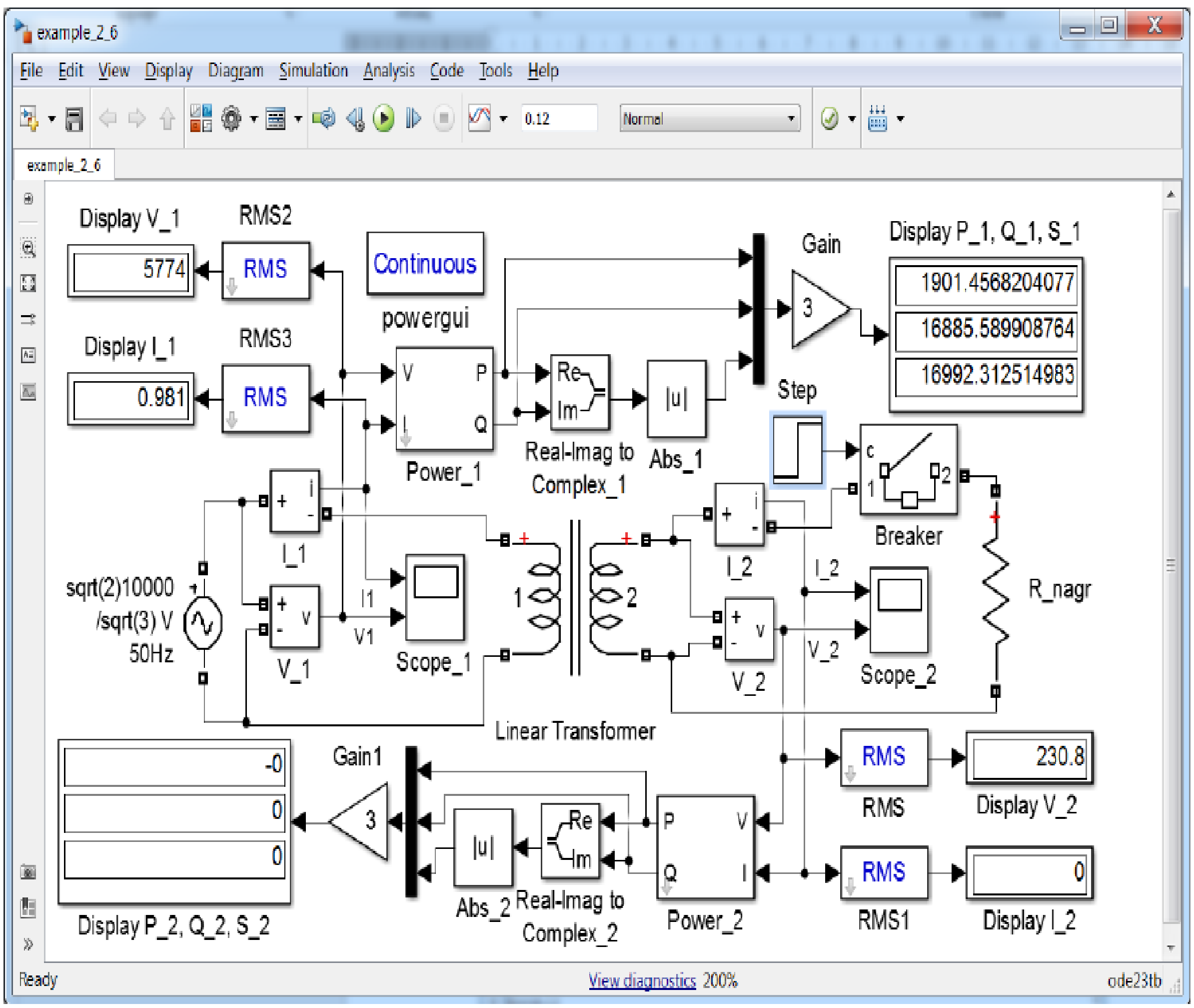

Figure 3. Working window to check the model in salt mode

The model is started and the results of the short circuit mode are displayed on the working screen (Figure 4).

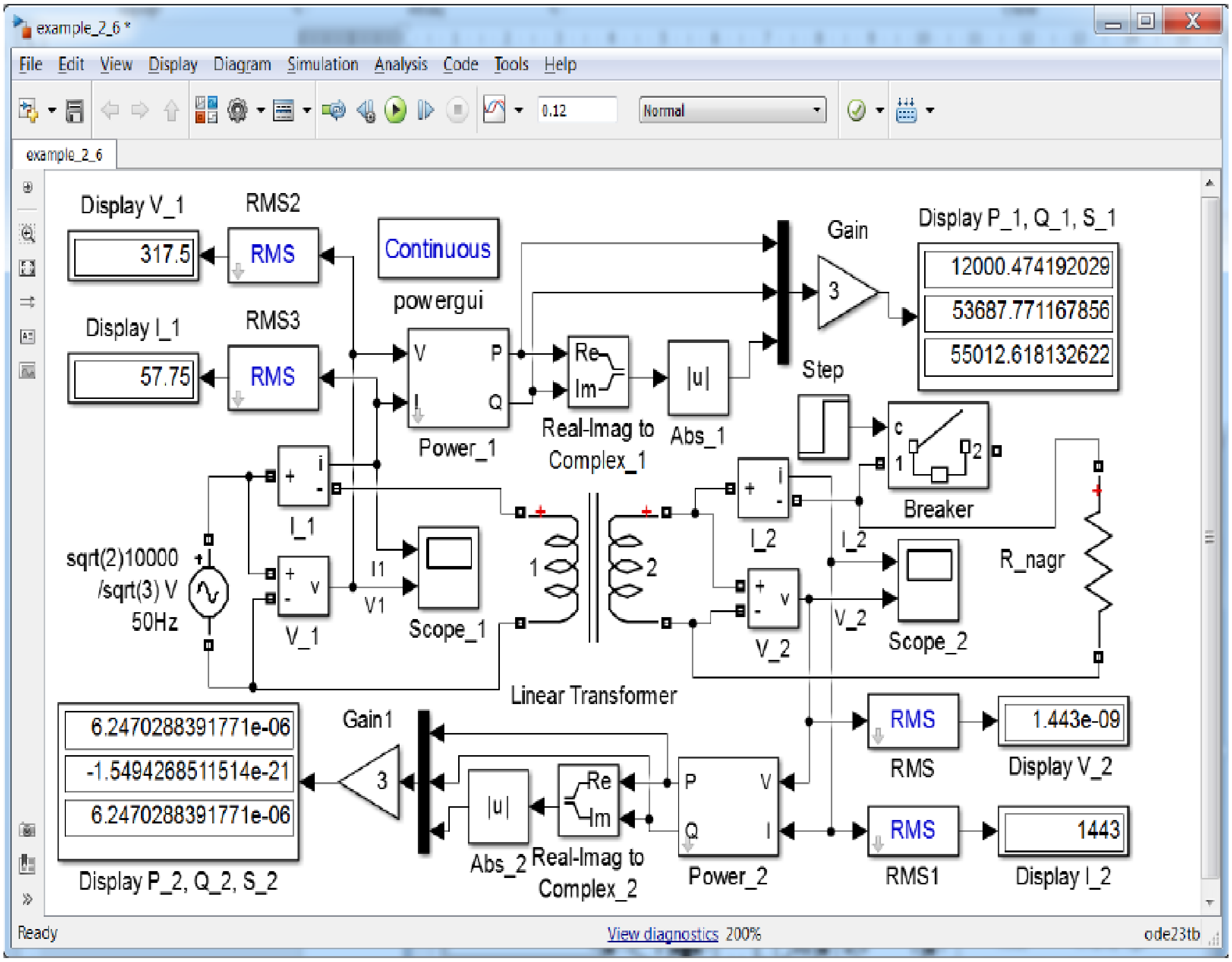

Figure 4. Working window to check the model for short circuit mode

The results obtained using the modeling are compared with the passport data of the transformer in tabular form.

The developed model is able to receive the currents and voltages of the operating mode. To do this, the powergui program in the Continuous block is placed on the working screen. The Steady-State Voltages and Currents button is pressed. For example, the second string is short-circuited and the Update Steady State values button is clicked to get the result.

For each experimental mode, the time and voltage dependences of Scope 1 and Scope 2 are generated over time (Figure 5).

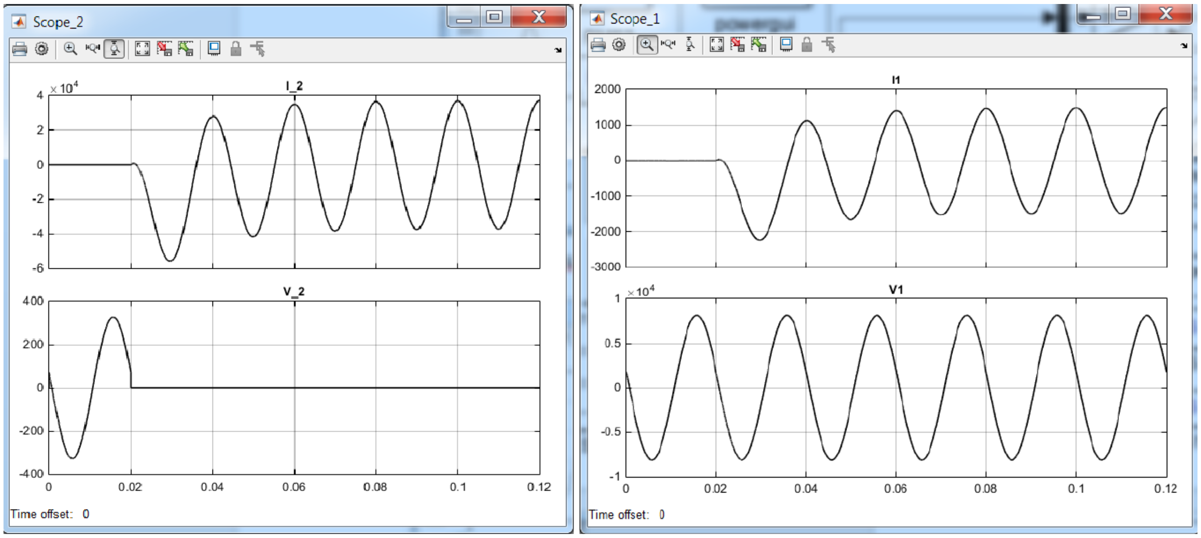

Figure 5. Time-dependent graphs of current and voltage in different modes

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