West Virginia University Lane Department of Computer Science and Electrical Engineering

Experiment #4 Single Phase Transformer

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Due Date: 09/27/23

Table of Contents:

Lab Handout:

No handout was provided for this lab

Objective & Equipment List for Each Experiment:

Objective:

The objective of this lab was to become familiar with the working principle of transformers. A two terminal transformer with a primary and secondary winding were simulated using Matlab and implemented on the workbench.

Equipment:

- wires
- 30V/10 A connection on variable isolated transformer/ exciter (200 V/ 2 A was not working)
- Multimeter unit
- Transformer unit : L2 was used
- Variable resistor Box

Procedure & Wiring Diagram

In experiment one a simple circuit is created in matlab to test the idea of ideal transformers. For experiment one, the circuit is set up and the instantaneous values of power are produced. In Experiment 2 these instantaneous values are converted into RMS values to produce useful results. After converting values to RMS, the circuit is implemented on the workstation (Experiment 3).

Experiment 1: Matlab

The following is a list of steps to obtain various required components for our transformer circuit:
Simulink library browser , simscape electrical ,
specialized power systems : **Power GUI block**.
Power grid elements - **linear transformer**
Specialized power systems - sources - **ac voltage source**
Sources - **ground**
Sensors and measurements - **2 voltage and 1 current measurement blocks**
Simulink - sinks - **3 display blocks**

After building the circuit, values of some components are changed as follows:

Double click linear transformer : 3 winding transformer

- Uncheck three winding transformer
- Winding 1 parameters : [220 0.002 0.08] (can handle 220 volts)

- Winding 2 parameters : [2400 0.002 0.08] (can handle 2400 volts)
- Nominal power and frequency stays the same

Apply

AC voltage source parameters : sqrt(2) times 220 volts , everything else same (RMS value is 220)

Change continuous block to discrete “for fun”

- Sample time is 0.0005

Finally, set stop time to 0.5 seconds and hit run.

Results are negative at all display boards : this is because the time you measure it is not really accurate … these are the instantaneous values and they have no meaning

We need RMS value.

Experiment 2: Matlab

Simscape electrical specialized power system sensors and measurements and drag three RMS blocks. Connect before each display board . this will convert the instantaneous values to rms values before displaying them

Hit run , now values are positive and make sense

220 volts applied to primary side (1) of transformer which results in 2400 volts at the secondary side

Calculate active power and reactive power for two displays on primary side of transformer

Use power phasor block - connect voltage and current in to get power P and Q this is primary side

For secondary side 100 ohm resistor (series RLC branch)

Source energizes the transformer which is why the primary side has more power than the secondary side. Since the transformer itself is inductive in nature it consumes some of the power itself

Measure p and q and voltage and current on the lab workstation…

Experiment 3

Implement matlab circuit on lab workstation and only measure power values on primary side.

Observed and/or Measured Results:

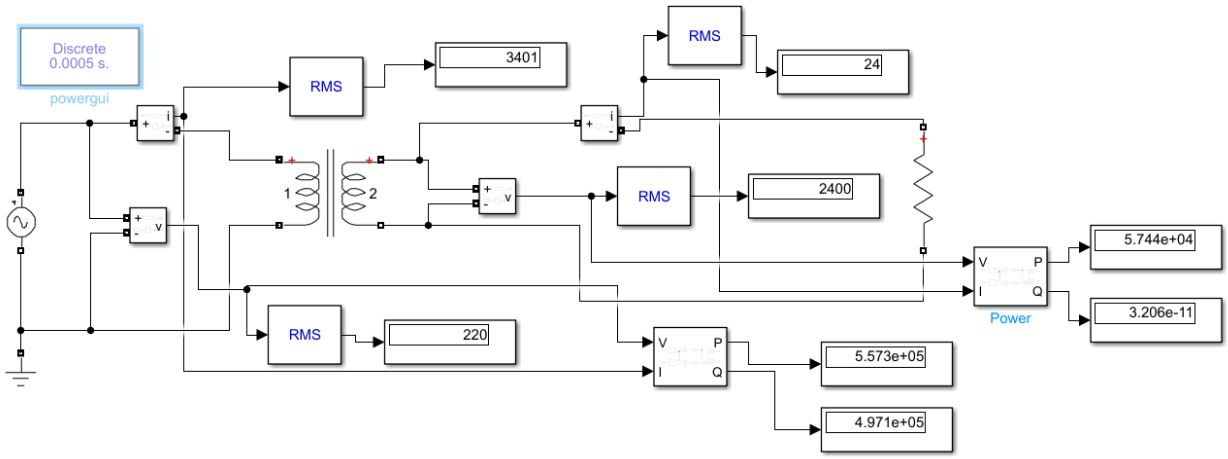

Figure 1. MATLAB setup of Transformer Circuit

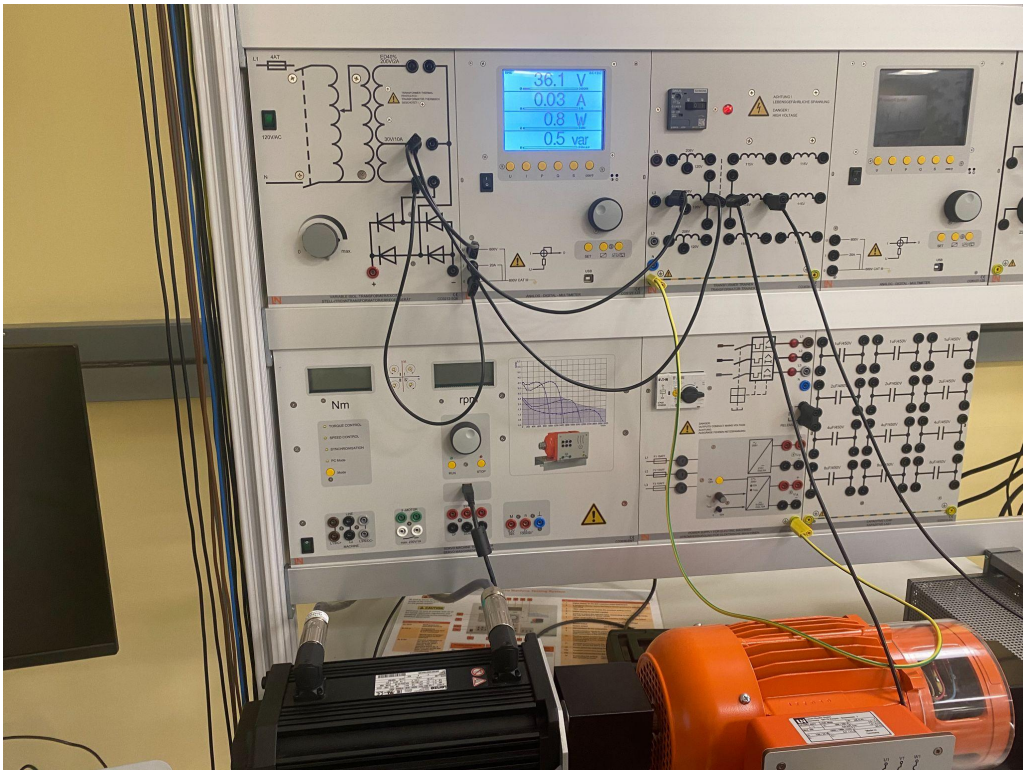

Figure 2. Primary Side Measurements

Observations and Conclusions:

Experiment 1:

After initially running the program, the results are negative on all display boards(real power and reactive power). This is because the time you measure it is not really accurate…these are the instantaneous values and they have no meaning.

Experiment 2:

The next step was applying RMS elements attached to the voltage and current on each side of the transformer. Each voltage and current block connected to their power element to display real and reactive power. This is displayed in the matlab figure above, each voltage and current output are connected to the RMS elemental block in matlab and are threaded through to display the volts and amperes on each side of the transformer for their primary and secondary values.

Experiment 3:

The third experiment was replicating the MATLAB circuit on the power board and in the figure above shows the primary side measurements. The power source is attached to the voltage and current while connected to the primary source of the transformer. The circuit is attached to ground using the yellow wire and the screen displays the values such as voltage, current, real power, and reactive power. Due to limitations, we were only able to draw source voltage of 36.1 volts and 0.03 ampere current. The real and reactive power on the primary side was 0.5 watts and 0.8 var. Based on the transformer we used the ratio of primary and secondary voltage was 208:115 meaning a turns ratio of around 1.8. So since our primary side voltage was 36.1 volts, our secondary side voltage should have been around 20 volts. The current on the secondary side would have been around 0.054 ampere.