SIMULINK MODELING OF THREE WINDINGS LINEAR TRANSFORMER AS A POWER DISTRIBUTION NETWORK

Adil Farooq[1], Nasir Naveed[1]
[1]Department of Electronic Engineering, International Islamic University Islamabad, Pakistan
*Corresponding author email: adil.farooq@iiu.edu.pk Tel: +92-322-5360038

ABSTRACT: *Transformers are widely used as a static machine in power distribution system. Distribution network connects the transmission and lower the voltage to 2KV to 35KV medium range. Primary distribution lines carry this voltage range to distribution transformers. In this paper we have modeled transformer to perform simulation based analysis in Simulink for three windings linear transformer using various parameters. Results show that the higher the flux linkage the better the current induced on the secondary winding loads.*

Key words: Linear Transformer, Power Distribution, Simulink

1. INTRODUCTION

Linear transformer can be used as a power distribution networks in homes as well as in the transmission level. An electric power distribution system is the final stage in the delivery of electric power; it carries electricity from the transmission system to individual consumers. It transfers electrical energy from one side to another without change in frequency [1]. Increasing loads especially non-linear on a transformer causes various effects decreasing the efficiency [2].

A lot of studies have been carried out for evaluating performance giving the detail of a tested single phase transformer. Yet most of them have focused only on the losses occurred due to harmonic effects [3-5]. Voltage regulation and efficiency are the main parameters of any transformer. To obtain open circuit and short circuit tests are conducted. The current is measured by applying single phase to primary side of a step down transformer. The variation of current in the transformer is observed at the primary side with respect to changing loads [6]. Efficiency is measure of output power of transformer delivered to load. Therefore it is important to calculate the efficiency of a transformer and voltage regulation [7].

The rest of the paper is organized as follows: Section 2 gives an overview of Linear Transformer while working principle is described in Section 3. The simulation setup in Section 4. Results are highlight in section 5 and paper is concluded in Section 6.

2. LINEAR TRANSFORMER

Linear transformer are used as power distribution network in housing needs serving as line to line and line to line loads which can be capacitive or inductive loads. The ideal transformer model assumes that all flux generated by the primary winding links all the turns of every winding, including itself. While practically, some flux navigate paths that take it outside the windings which results in leakage inductance in series with the mutually coupled transformer windings. Leakage flux results in energy being alternately stored in and discharged from the magnetic fields with each cycle of the power supply. It is not directly a power loss, but results in inferior voltage regulation causing the secondary voltage not to be directly proportional to the primary voltage, particularly under heavy load transformers are therefore normally designed to have very low leakage inductance

3. WORKING PRINCIPLE

A transformer is a static electro-magnetic passive electrical device working on the principle of induction converting electrical energy from one amplitude to another. The transformer does this by linking together two or more electrical circuits using a common oscillating magnetic circuit which is produced by the transformer itself. A single phase voltage transformer basically consists of two electrical coils of wire. In a single-phase voltage transformer the primary is usually the side with the higher voltage.

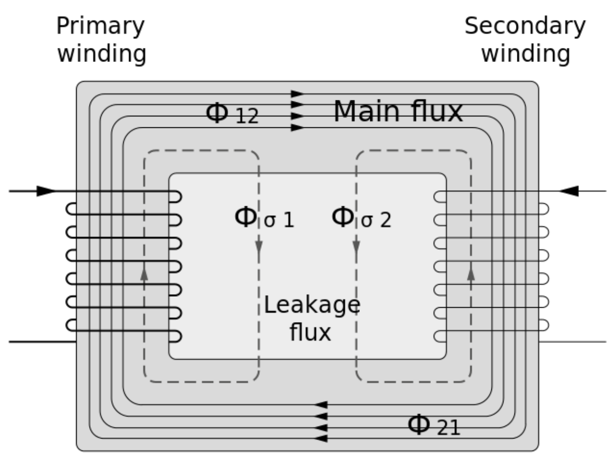

Figure 1 Basic Transformer

4. SIMULATION SETUP

A linear three windings transformer can be setup in Matlab using Simulink for many application circuits. Linear transformer as a power distribution transformer is set in Simulink with following simulation settings. To implement three winding transformer in Matlab first of all we selected some of the parameters of the transformer block as shown below.

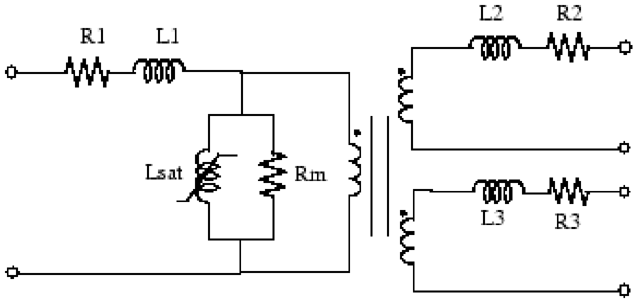

Figure 2 Three Winding Transformer Equivalent Circuit

4.1 Parameter Selected for the Transformer Block

In the below block if we check the three winding transformer then the third winding will be selected otherwise only two windings will be added as shown in figure 3. If we want to select the ideal transformer then the windings resistance must be zero for the ideal transformer. In the above block we have set for a 150kVA transformer with 50 HZ frequency.

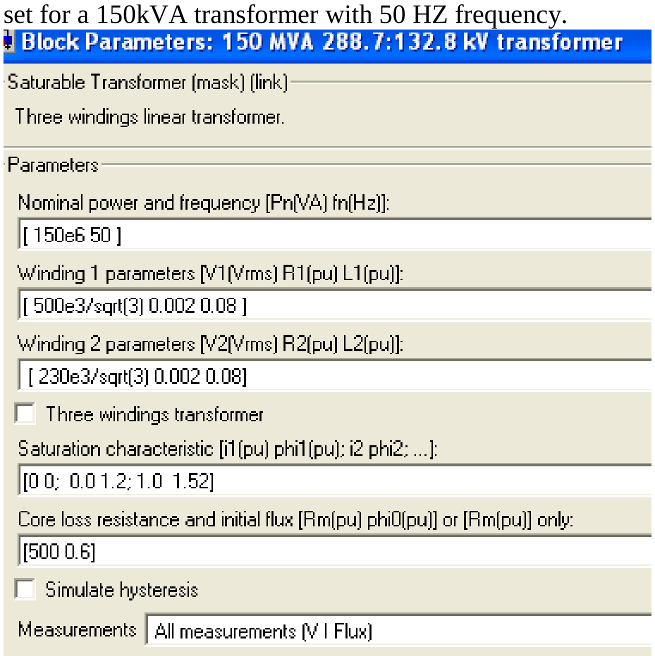

Figure 3 Selected Transformer Parameters

4.2 Primary Voltage Parameters for Transformer

We have set for a 230V transformer with 50 HZ frequency.

Block Parameters:

*Peak Amplitude(V) = 230*sqrt(2)*
Phase Degree (deg) = 0
Sample Time = 0
Frequecy (Hz) = 50

4.3 Loads applied to the transformer

The Loads are applied to the seconday of Trnasformer as shown below in Figure 4.

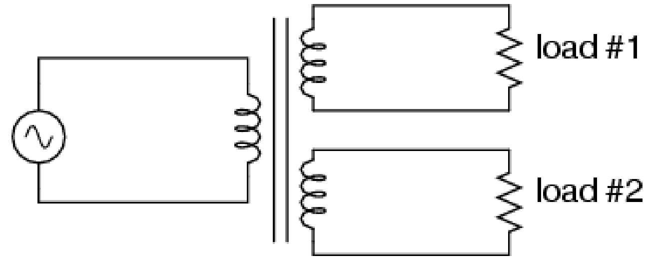

Figure 4 Transformer Loads

4.4 Secondary Line to Line and Neutral Loads

Line to line and line to neutral loads applied to secondary of the transformer as shown below in Figure 5.

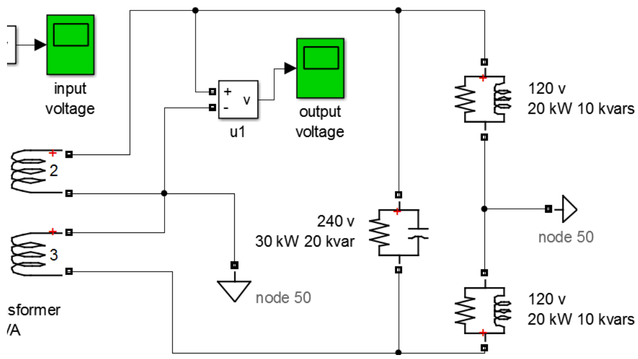

Figure 5 Loads Applied in Simulation

4.5 Capacitive Load Selection on Secondary

In selecting the capacitive load to the secondary winding in the circuit of the transformer we have used the capacitor values as shown in Figure 8.

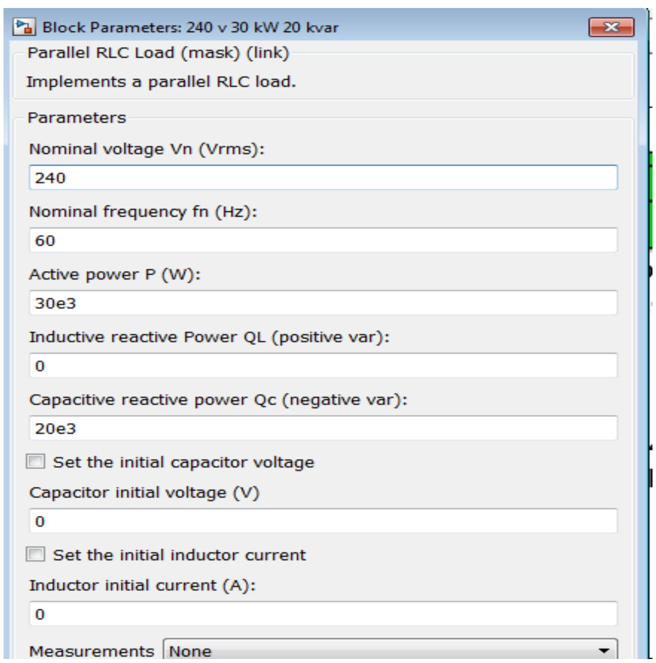

Figure 6 Capacitive Load Parameters

4.6 Inductive Load Selection on Secondary

In selecting the inducting load to the secondary winding in the circuit of the transformer you muse uncheck the capacitor in the RLC branch of Figure 7 to select the inductive load .than write the values of the inductor or capacitor you want of your desired.

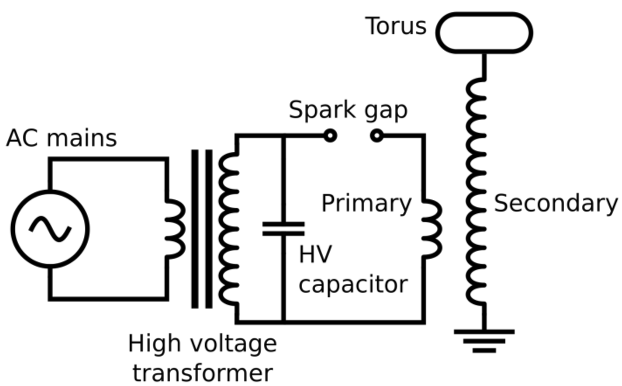

Figure 7 RLC Branch of a Transformer

In selecting the inductive load to the secondary winding in the circuit of the transformer we have used the values as shown in Figure 8.

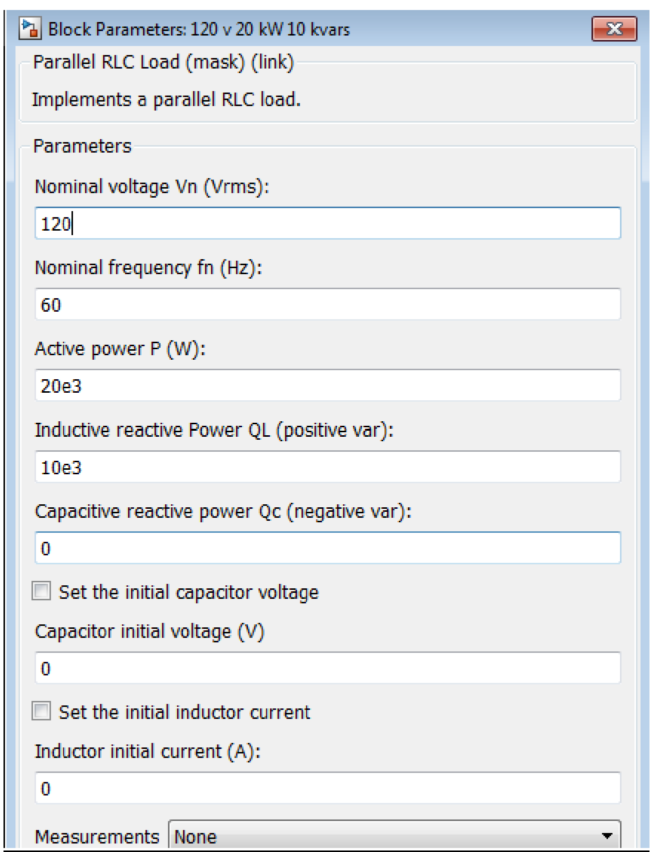

Figure 8 Inductive Load Parameters

4.7 Simulink Model for a Three Windings Linear Transformer as Power Distribution Network

The following figure 9 shows the complete model of our distribution network of three winding linear transformer.

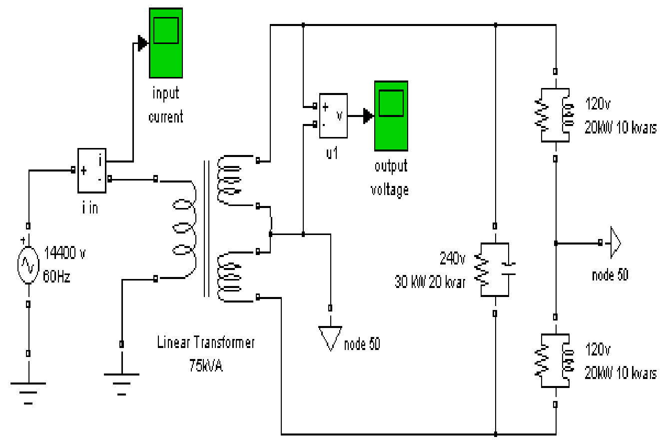

Figure 9 Model of Three Windings Linear Transformer

To model the three winding transformer we used the block specifications to enter the desired values of resistance and inductance. Transformer is given by power rating and frequency was specified as mentioned in previous section.

5. RESULTS

The current measured flowing in the secondary is 2.5 A constant with 2.5 V rms or 3.54 V peak as shown in Figure 10. The CT flux changes from initial zero maximum 1 pu and 0.8 pu showing almost constant flux density over time with a difference of 0.22 pu.

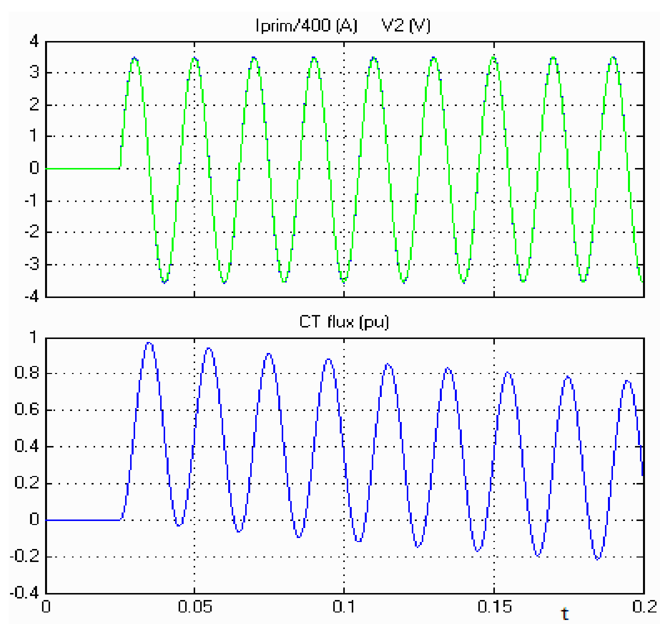

Figure 10 Secondary Current of CT and Flux

6. CONCLUSION

Information from transformer manufacturers complies with the simulated results and shows good validation and agreement. A three winding linear transformer suits well for power distribution network to its high percentage of flux density and current at high voltages.

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