ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

Comparison, Simulation and Analytical Investigation of Voltage Current and Power Waveforms of the at Eight Different Combination Step-up and Step-down Single Phase Transformer

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Abstract:- This article investigates different currents, voltages and powers of four different step-down and four different step-up autotransformers fed sinusoidally for analytical and simulation conditions. In this paper, analytical modeling and equations for step-down and step-up autotransformer based on current point signal and voltage polarity are presented. A discussion based on their theoretical use is then presented in the simulation along with calculations regarding their power performances. These models are also validated by simulation results of current, voltage and power waveforms for each analytical case. PSpice program is used for this simulation.

Keywords:- *Autotransformer Modeling, Polarity. Autotransformer Simulation, Step-Down Autotransformer, Step-Up Autotransformer.*

I. INTRODUCTION

Fewer turns in autotransformers, smaller core and overall size, hence lower cost, higher efficiency due to lower losses, better regulation, smaller equivalent power, hence smaller size and exciting current. [1].

The advantage of autotransformer is material saving and smaller dimensions at the same operating parameters (voltage, current, power). The serial winding of autotransformer has fewer turns than the primary winding of transformer. [2].

II. MATHEMATİCAL MODELS AND RESULTS

To insure correct wiring, polarity marks are shown on connection diagrams. The polarity mark is usually shown as a round dot, on or adjacent to terminals. An ideal transformer circuit as a controlled source is shown Figure 1.

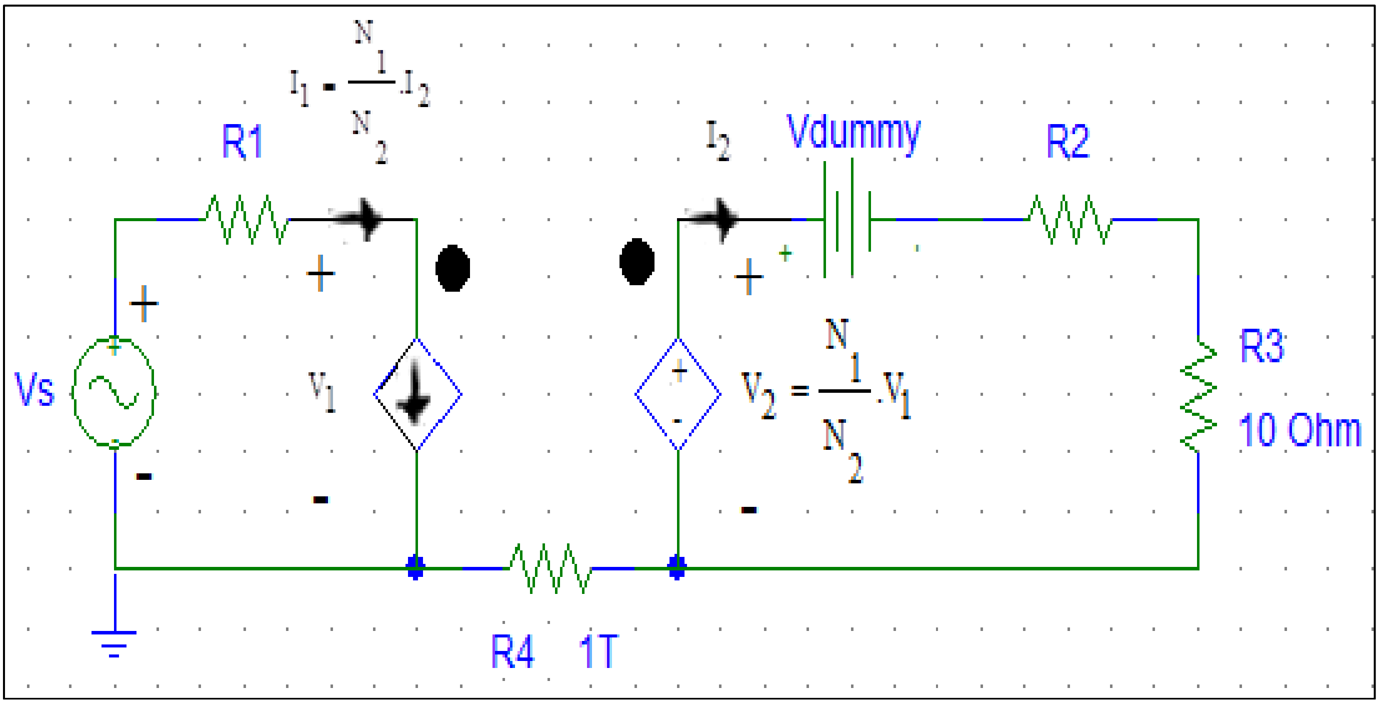

Fig 1: Controlled Sources Single-Phase Step-Down Transformer Equivalent Circuit

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A step-down transformer is a transformer where the delivered voltage is less than the supplied voltage..

$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{4}{1} \quad V_1 = 4xV_2$

$V_1 = 220 = V_s$

$V_2 = \frac{V_1}{4} = 55V$

$\frac{I_1}{I_2} = -\left(\frac{-N_2}{+N_1}\right) = -\left(\frac{-1}{+4}\right) = \frac{1}{4}$

$I_1 = 0{,}25xI_2$

$I_2 = 4xI_1$

$I_2 = \frac{V_2}{R_L} = \frac{55}{10} = 5{,}5A$

$I_1 = 0{,}25xI_2 = 1{,}3755A$

$P_s = V_sxI_1 = 220x1{,}375 = 302{,}5W$

$P_L = R_LxI_2^2 = 10x5{,}5^2 = 302{,}5W$

$P_{V1} = V_1xI_1 = 220x1{,}375 = 302{,}5W$

$P_{V2} = V_2xI_2 = 55x5{,}5 = 302{,}5W$

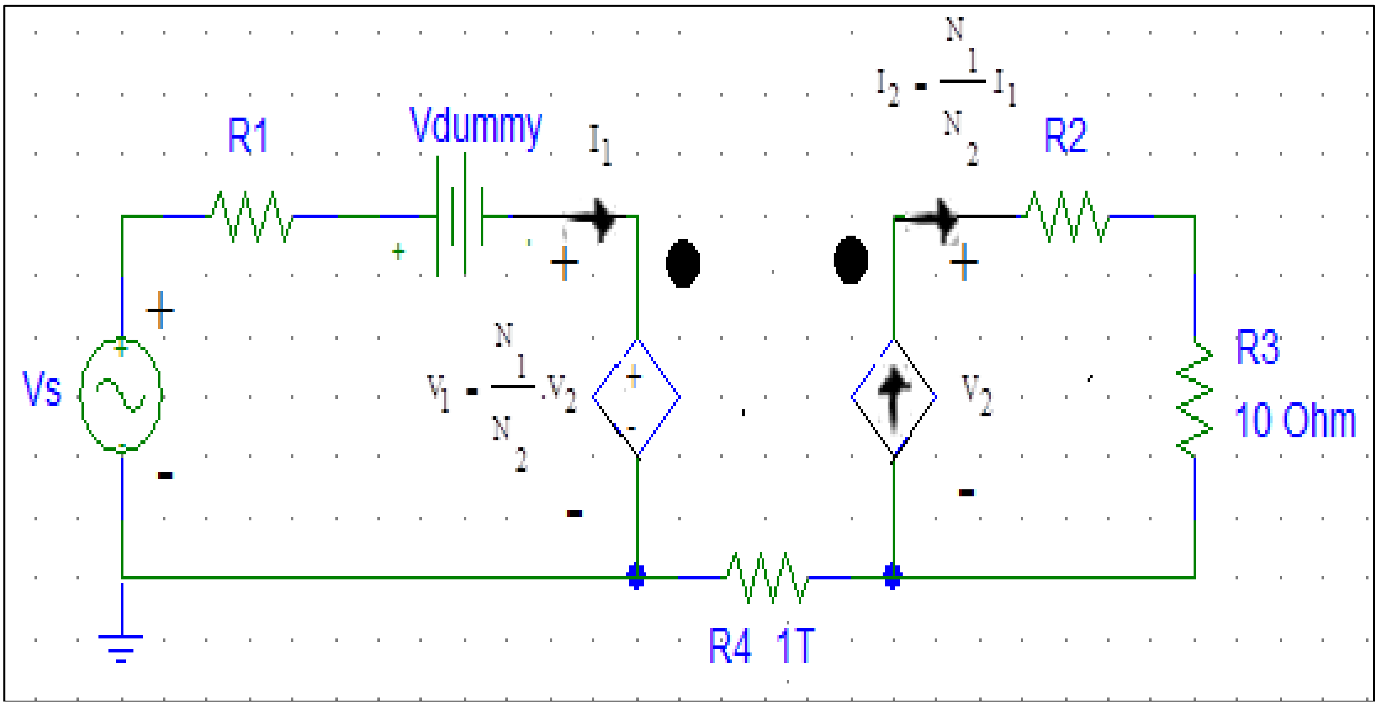

Fig 2: Controlled Sources Single-Phase Step-Up Transformer Equivalent Circuit

A step-up transformer is transformer in which delivered voltage is higher than the supplied voltage.

$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{1}{4}$

$V_2 = 4xV_1$

$V_1 = 3{,}4375V = V_s$

$V_2 = 4xV_1 = 13{,}75V$

$\frac{I_1}{I_2} = -\left(\frac{-N_2}{+N_1}\right) = -\left(\frac{-4}{+1}\right) = \frac{4}{1}$

$I_1 = 4.I_2$
$I_2 = +0{,}25.I_1$

$I_2 = \frac{V_2}{R_L} = \frac{13{,}75}{10} = 1{,}375A$

$I_1 = 4xI_2 = 4x1{,}375 = 5{,}5A$

$P_s = V_sxI_1 = 3{,}4375x5{,}5 = 18{,}90625W$

$P_L = R_LxI_2^2 = 10x1{,}375^2 = 18{,}90625W$

$P_{V1} = V_1xI_X = 3{,}4375x5{,}5 = 18{,}90625W$

$P_{V2} = V_2xI_2 = 13{,}75x1{,}375 = 18{,}90625W$

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

III. THE RESULTS THAT WERE OBTAINED FROM THE SIMULATION OF THE AUTOTRANSFORMER CALCULATED FOR EVERY CASES

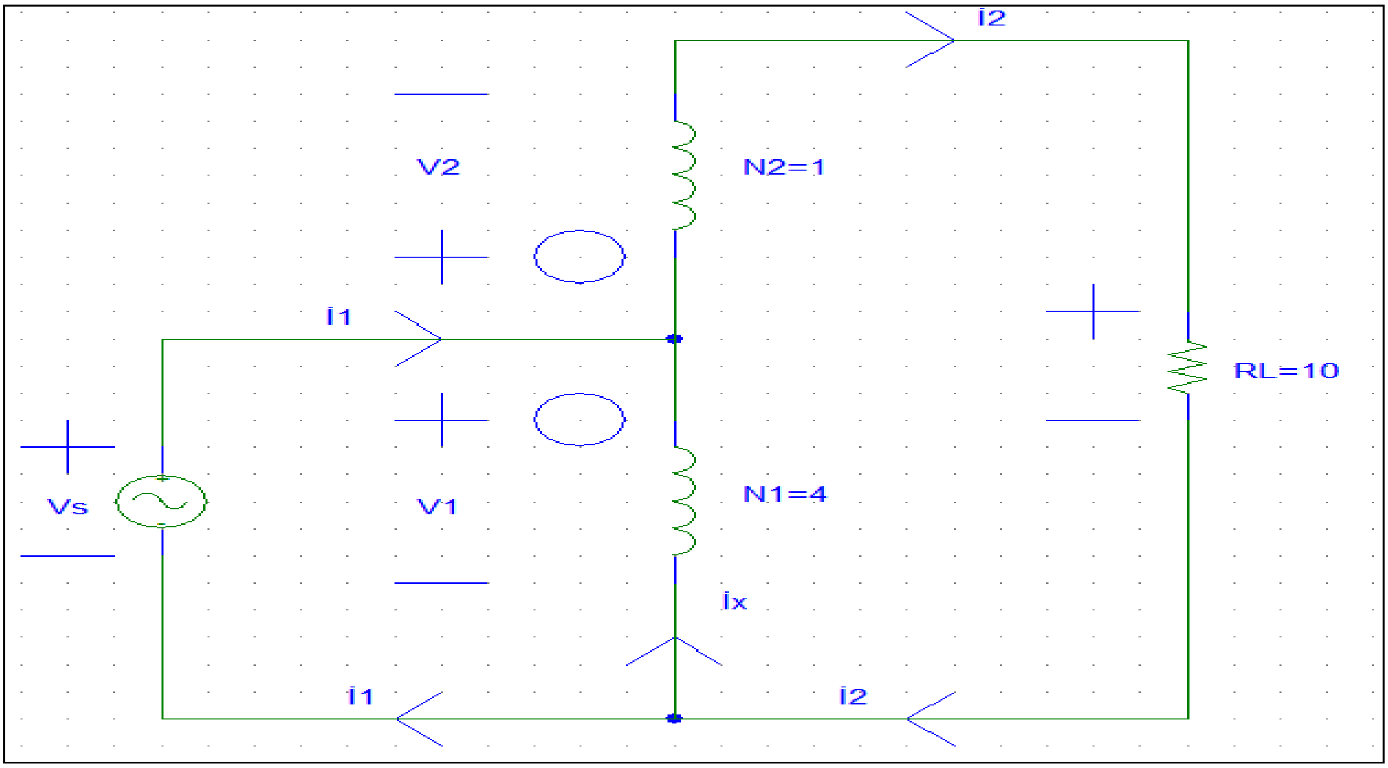

Fig 3a): The Circuit of the Step-Up Autotransformer

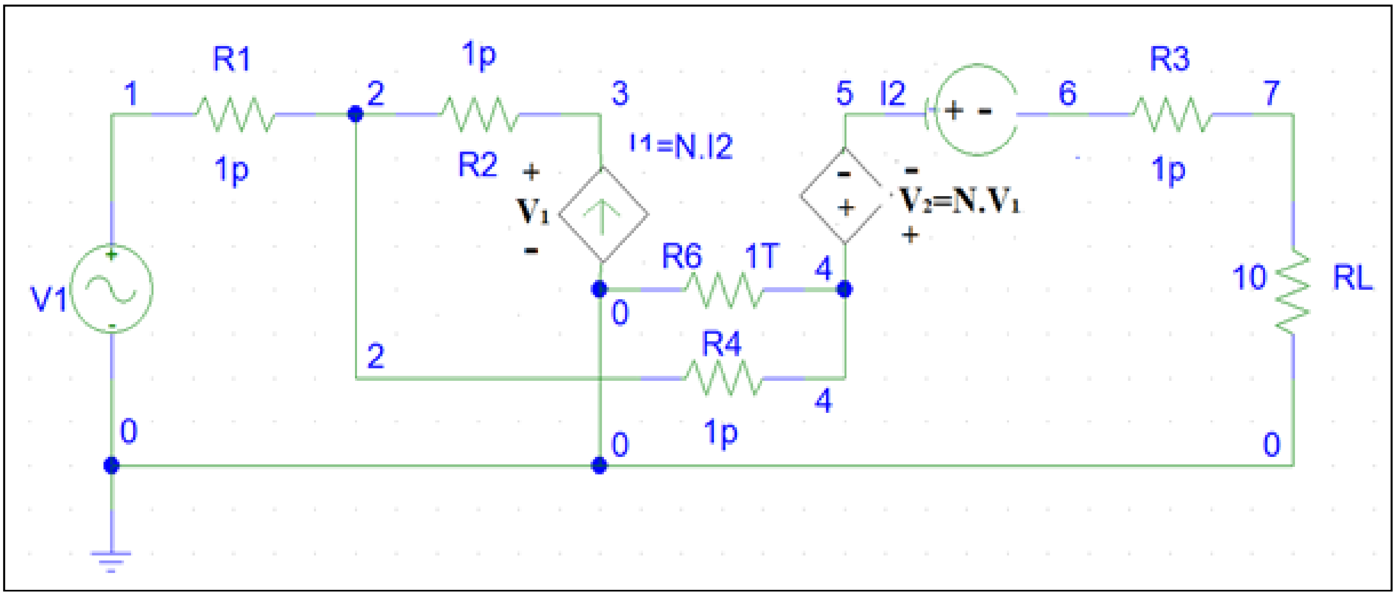

Fig 3b): In Figure 3.a, the Step-up Autotransformer is Redrawn for PSpice Analysis

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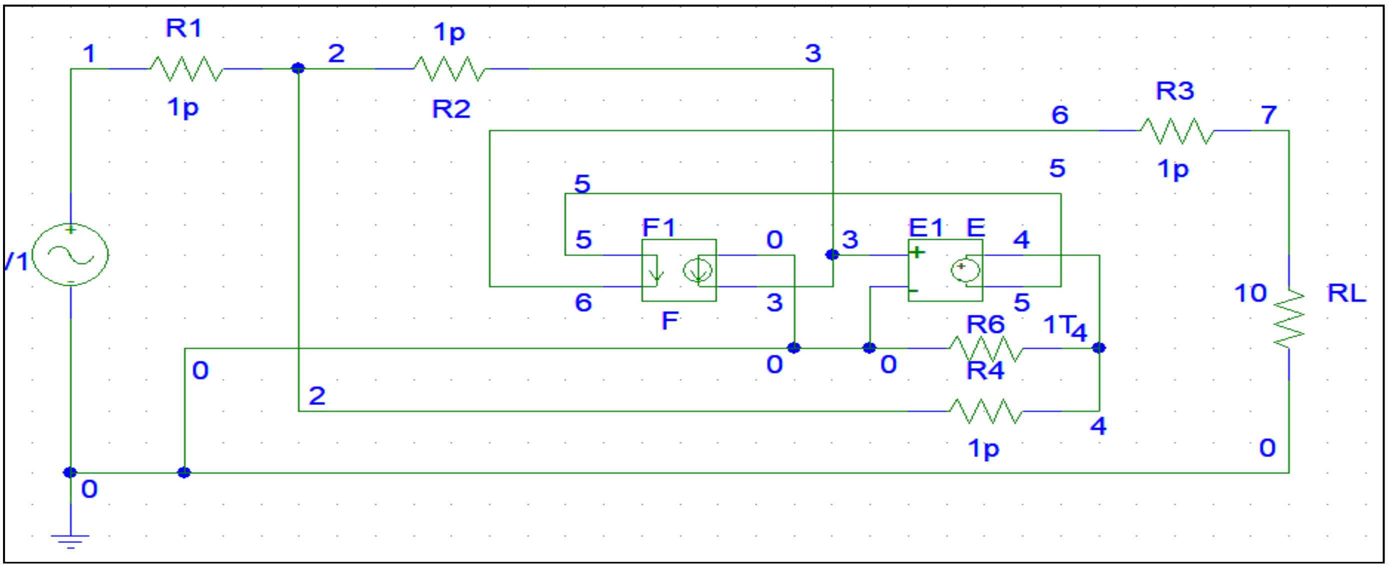

Fig 3c): The Circuit Diagram of Figure 3b has been Redrawn for PSpice Schematic Analysis.

The results that was obtained from the simulation of the step-up autotransformer calculated for Case Fig.3.a..

$$\frac{V_1}{V_1+V_2} = \frac{N_1}{N_1+N_2} = \frac{4}{4+1} = \frac{4}{5}$$

$$V_1 = 4xV_2$$

$$V_1 = 73{,}33V = V_s$$

$$V_2 = \frac{V_1}{4} = 18{,}3V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_1+N_2}{+N_1}\right) = -\left(\frac{-4+1}{+4}\right) = \frac{3}{4}$$

$$I_1 = 0{,}75xI_2$$

$$I_2 = +1{,}333xI_1$$

$$I_2 = \frac{V_1-V_2}{R_L} = 5{,}5A$$

$$I_1 = 0{,}75xI_2 = 4{,}125A$$

$$I_x = I_2 - I_1 = 1{,}375A$$

$$P_s = V_s xI_1 = 73.33x4{,}125 = 302{,}5W$$

$$P_L = R_L xI_2^2 = 10x4{,}125^2 = 302{,}5W$$

$$P_{V1} = V_1 xI_X = 73{,}33x1{,}375 = 100{,}833W$$

$$P_{V2} = V_2 xI_2 = 18{,}33x5{,}5 = 100{,}833W$$

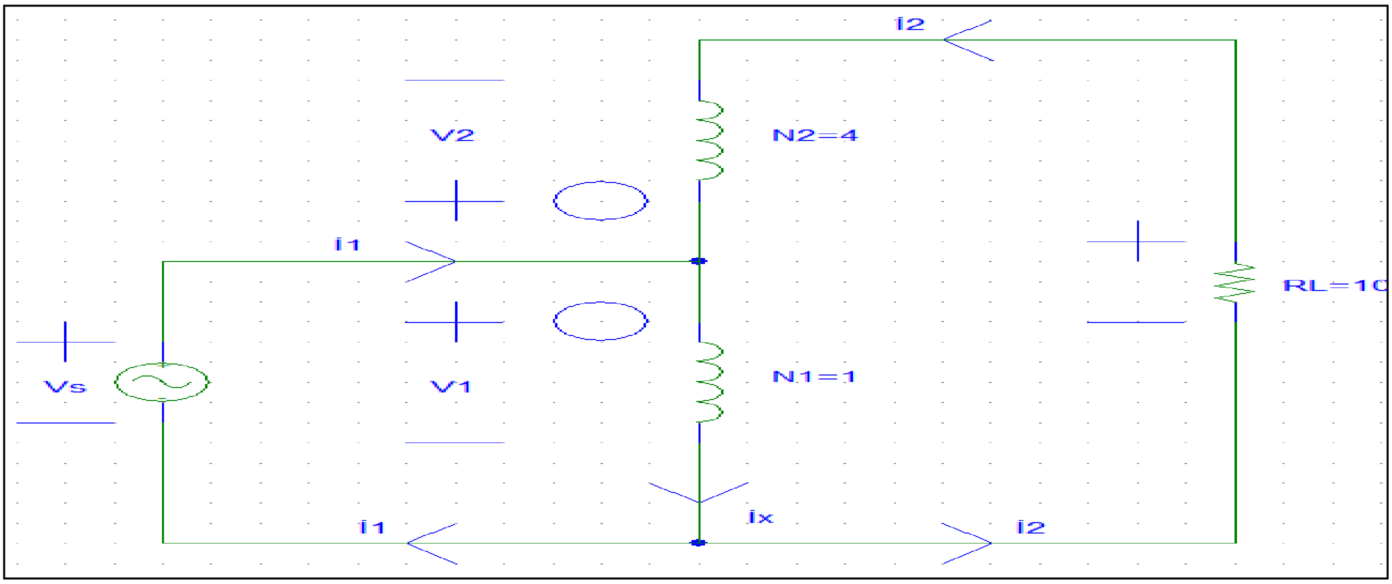

Fig 4a): The Circuit of the Step-up Autotransformer

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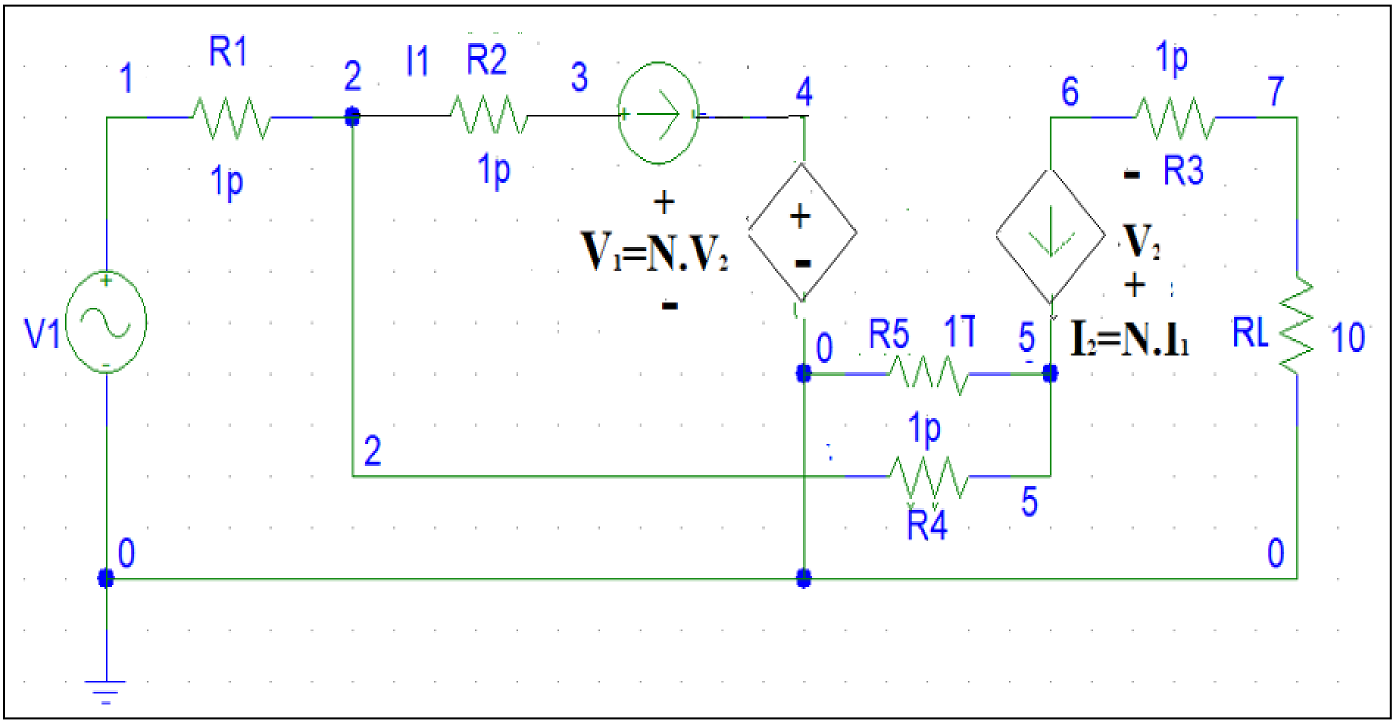

Fig 4b): In Figure 4.a, the Step-Up Autotransformer is Redrawn for PSpice Analysis

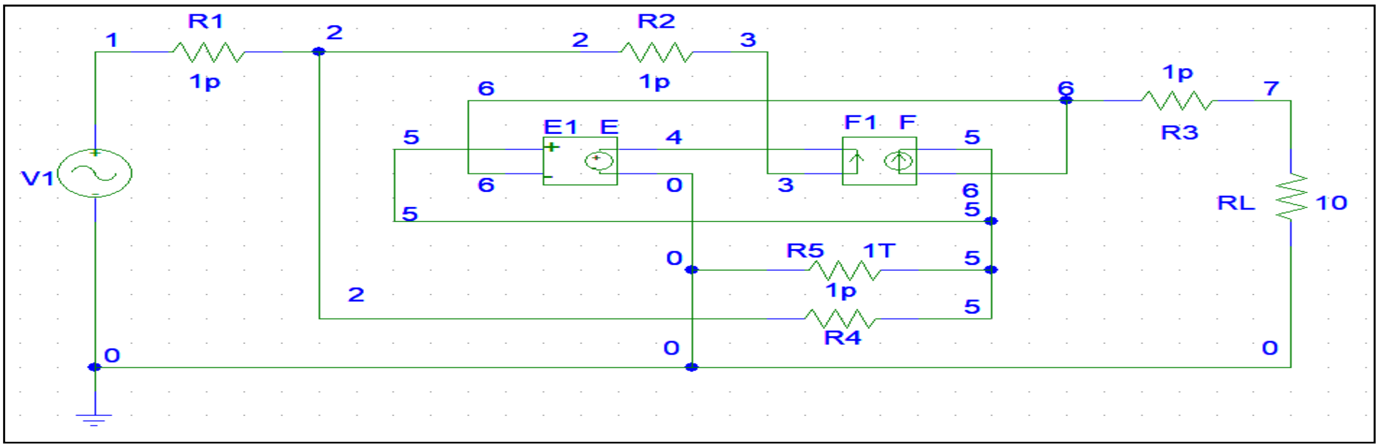

Fig 4c): The Circuit Diagram of Figure 4.b has been Redrawn for PSpice Schematic Analysis

The results that was obtained from the simulation of the stepup autotransformer calculated for a Case Fig.4.a.

$$\frac{V_1}{V_1+V_2} = \frac{N_1}{N_1+N_2} = \frac{1}{1+4} = \frac{1}{5}$$

$$V_2 = 4xV_1$$

$$V_1 = 4{,}5833V = V_s$$

$$V_2 = 4xV_1 = 18{,}3V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_2+N_1}{+N_1}\right) = -\left(\frac{-1+4}{+1}\right) = \frac{3}{1}$$

$$I_1 = 3.I_2$$

$$I_2 = +0{,}333.I_1$$

$$I_2 = \frac{V_2-V_1}{R_L} = 1{,}375A$$

$$I_1 = 3xI_2 = 4{,}125A$$

$$I_x = I_1 + I_2 = 5{,}5A$$

$$P_s = V_s xI_1 = 4{,}583x4{,}125 = 18{,}90625W$$

$$P_L = R_L xI_2^2 = 10x1{,}375^2 = 18{,}90625W$$

$$P_{V1} = V_1 xI_X = 4{,}5833x5{,}5 = 25{,}2083W$$

$$P_{V2} = V_2 xI_2 = 18{,}333x1{,}375 = 25{,}2083W$$

ISSN No:-2456-2165
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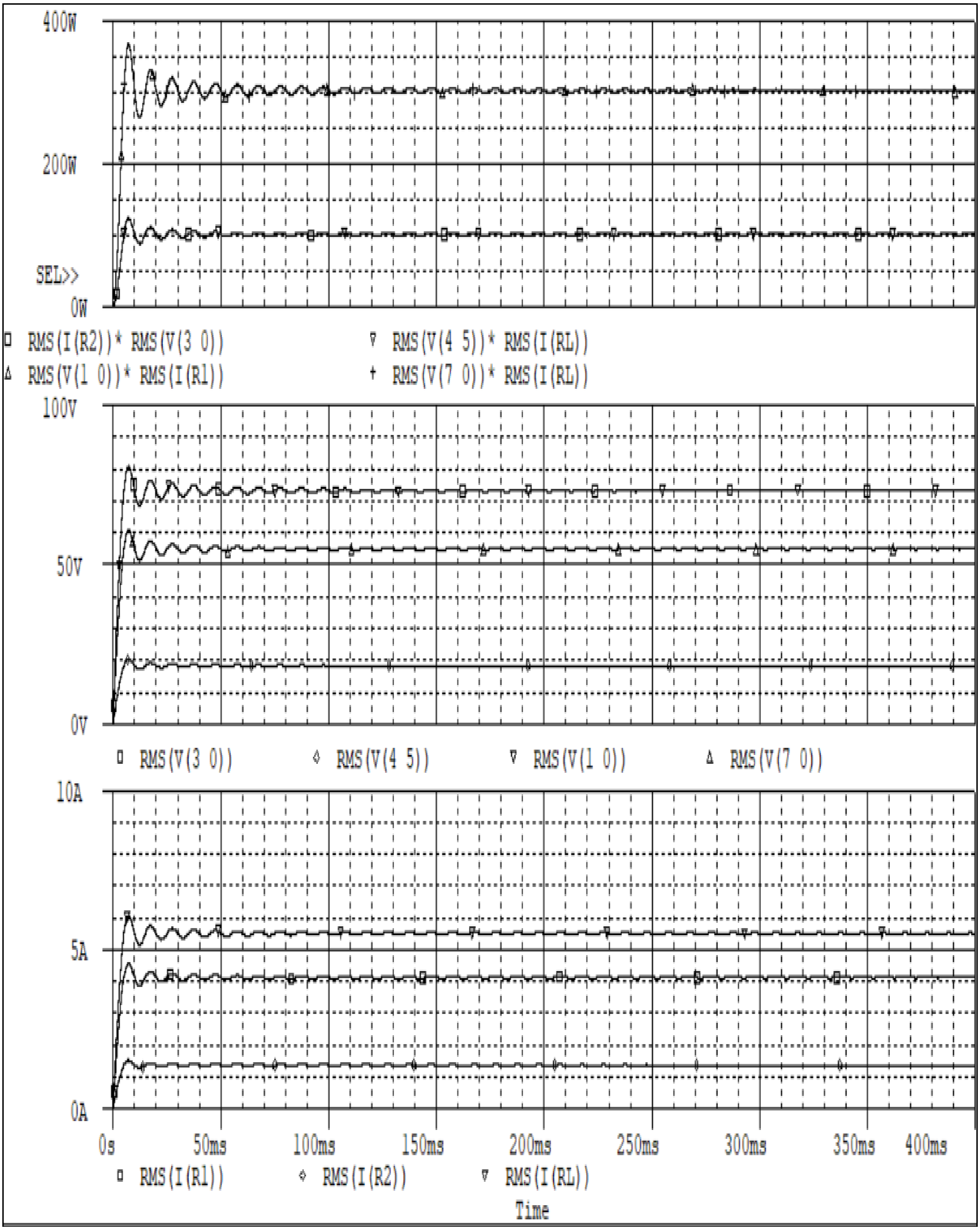

Fig 3d): PSpice plot of Voltages, Currents and Powers of Step-Up Autotransformer (Stepdown Transformer-A Step-Down Transformer is a Transformer Where the Delivered Voltage is Less Than the Supplied Voltage) Case for Fig. 3-c

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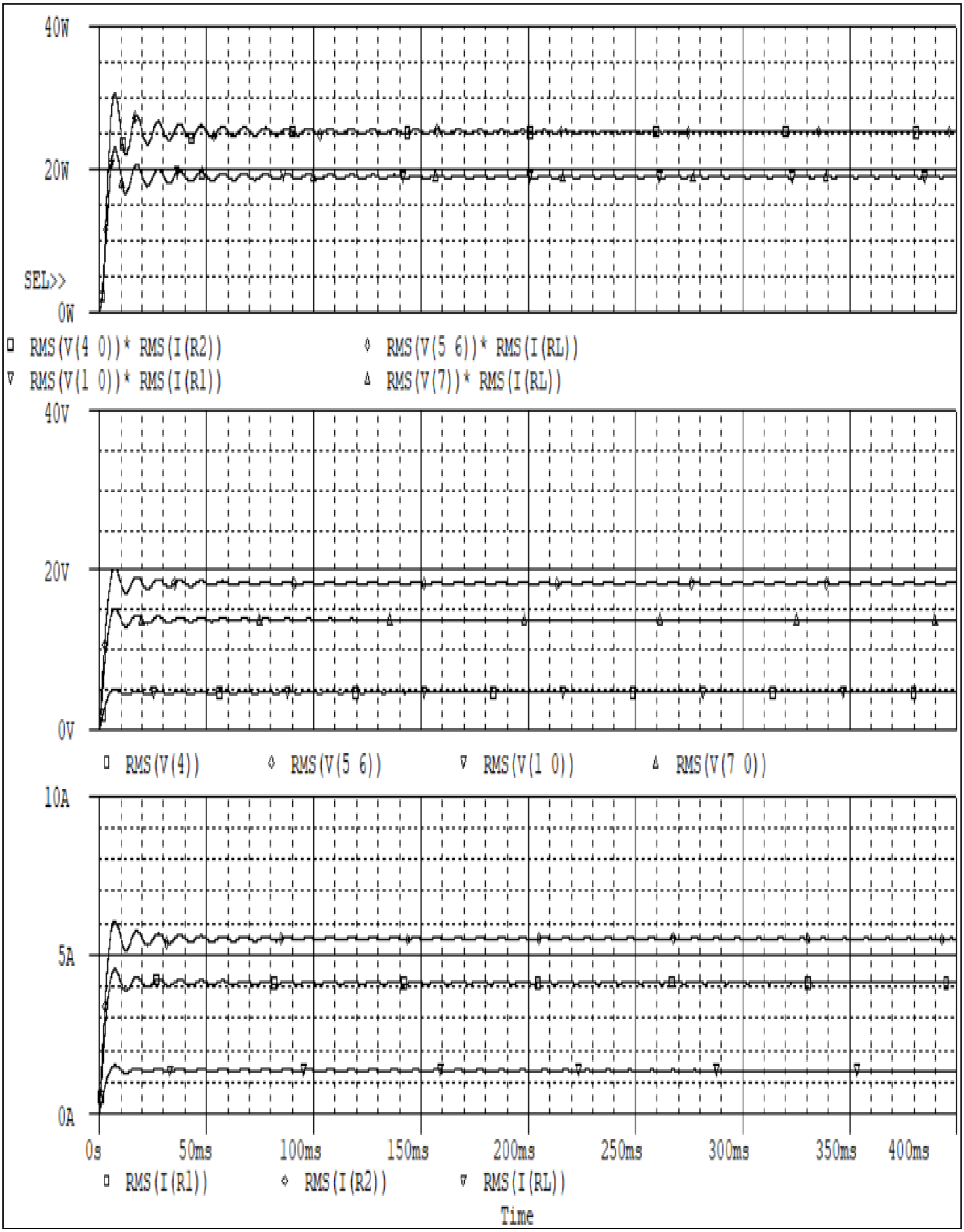

Fig 4d): PSpice Plot of Voltages, Currents and Powers of Step-Up Autotransformer (Stepup Transformer-A Step-Up Transformer is Transformer in Which Delivered Voltage is Higher than the Supplied Voltage.) Case for Fig.4.c.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

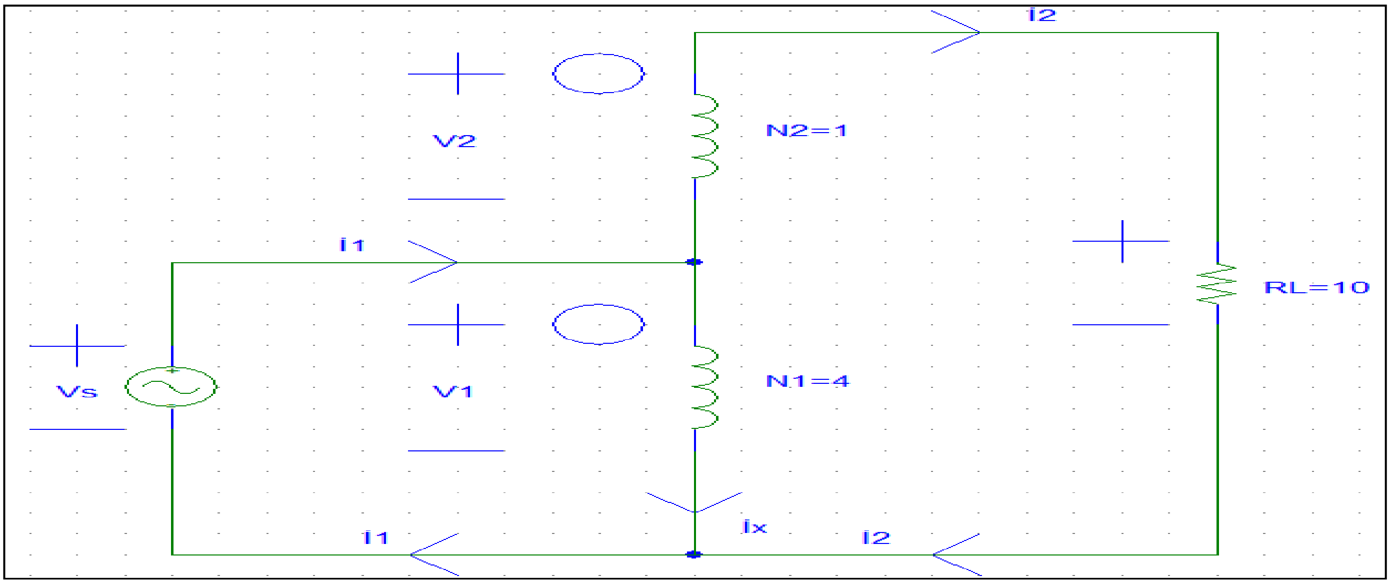

Fig 5a): The Circuit of the Step-Up Autotransformer

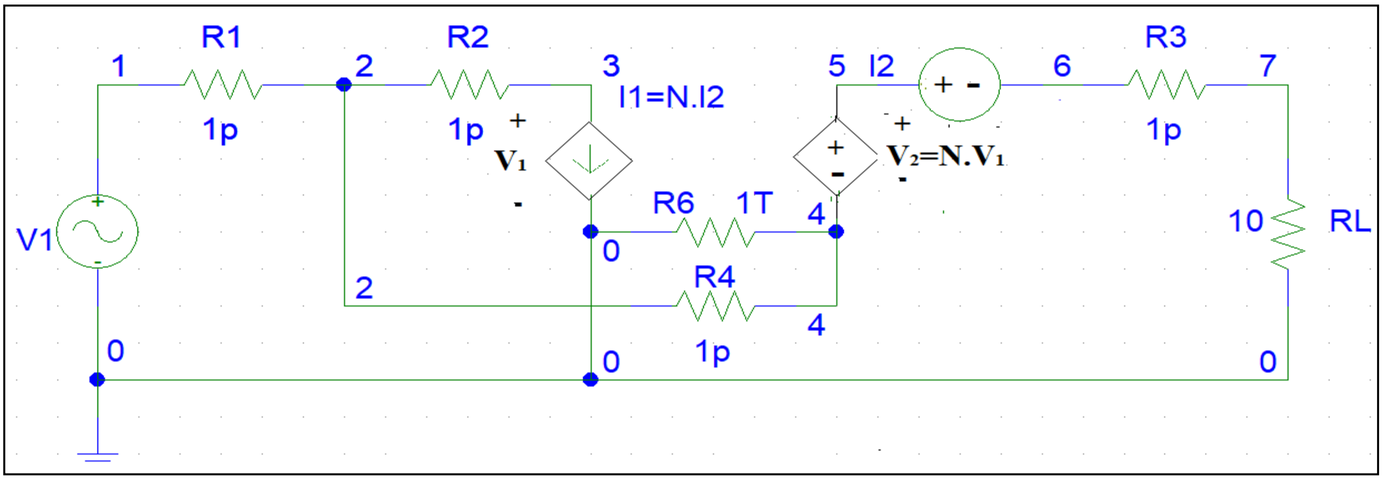

Fig 5b): In Figure 5.a, the Step-Up Autotransformer is Redrawn for PSpice Analysis

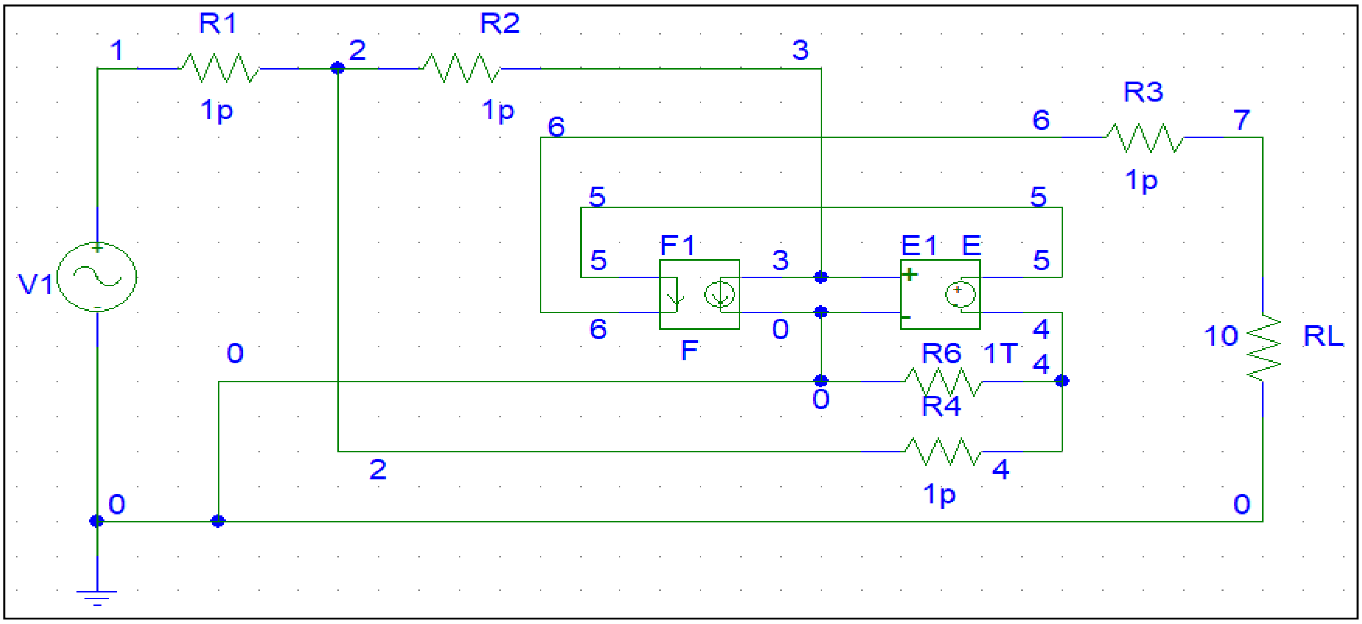

Fig 5c): The Circuit Diagram of Figure 5.b has been Redrawn for PSpice Schematic Analysis. Analysis

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The results that was obtained from the simulation of the stepup autotransformer calculated for Case for Fig. 5.a.

$$\frac{V_1}{V_1+V_2}=\frac{N_1}{N_1+N_2}=\frac{4}{4+1}=\frac{4}{5}$$

$$V_1=4xV_2$$

$$V_1=44V=V_s$$

$$V_2=\frac{V_1}{4}=11V$$

$$\frac{I_1}{I_2}=-\left(\frac{-N_1-N_2}{+N_1}\right)=-\left(\frac{-4-1}{+4}\right)=\frac{5}{4}$$

$$I_1=1{,}25xI_2$$

$$I_2=0{,}8xI_1$$

$$I_2=\frac{V_1+V_2}{R_L}=\frac{44+11}{10}=5{,}5A$$

$$I_1=1{,}25xI_2=6{,}875A$$

$$I_x=I_1-I_2=1{,}375A$$

$$P_s=V_sxI_1=44x6{,}875=302{,}5W$$

$$P_L=R_LxI_2^2=10x5{,}5^2=302{,}5W$$

$$P_{V1}=V_1xI_X=44x1{,}375=60{,}5W$$

$$P_{V1}=V_2xI_2=11x5{,}5=60{,}5W$$

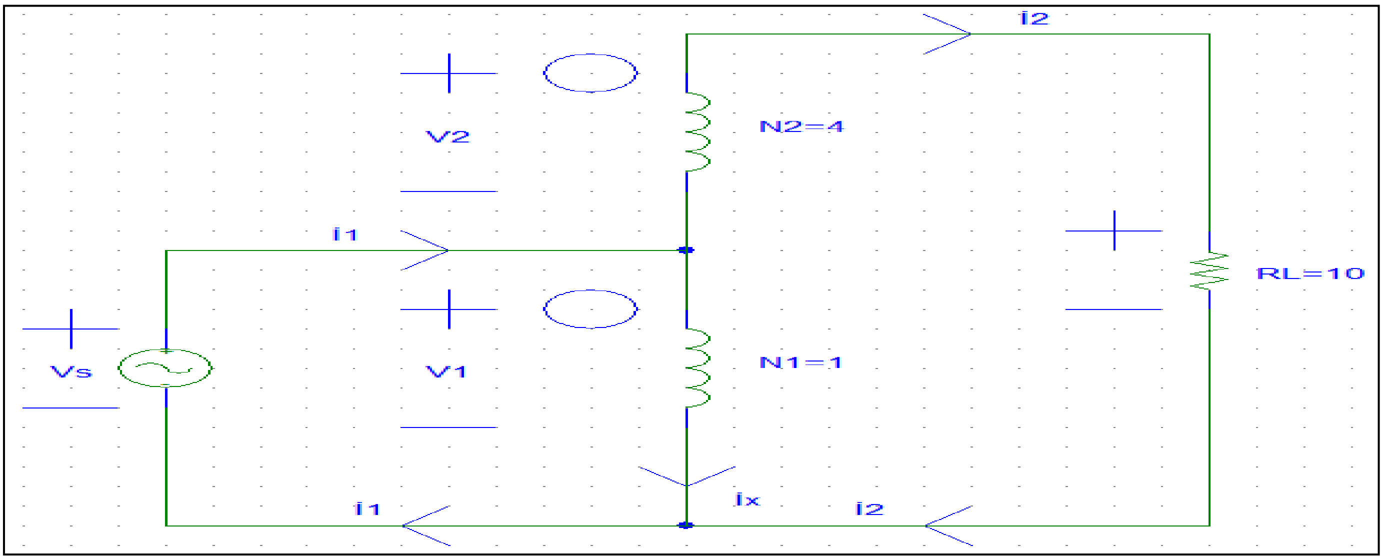

Fig 6a): The Circuit of the Step-Up Autotransformer

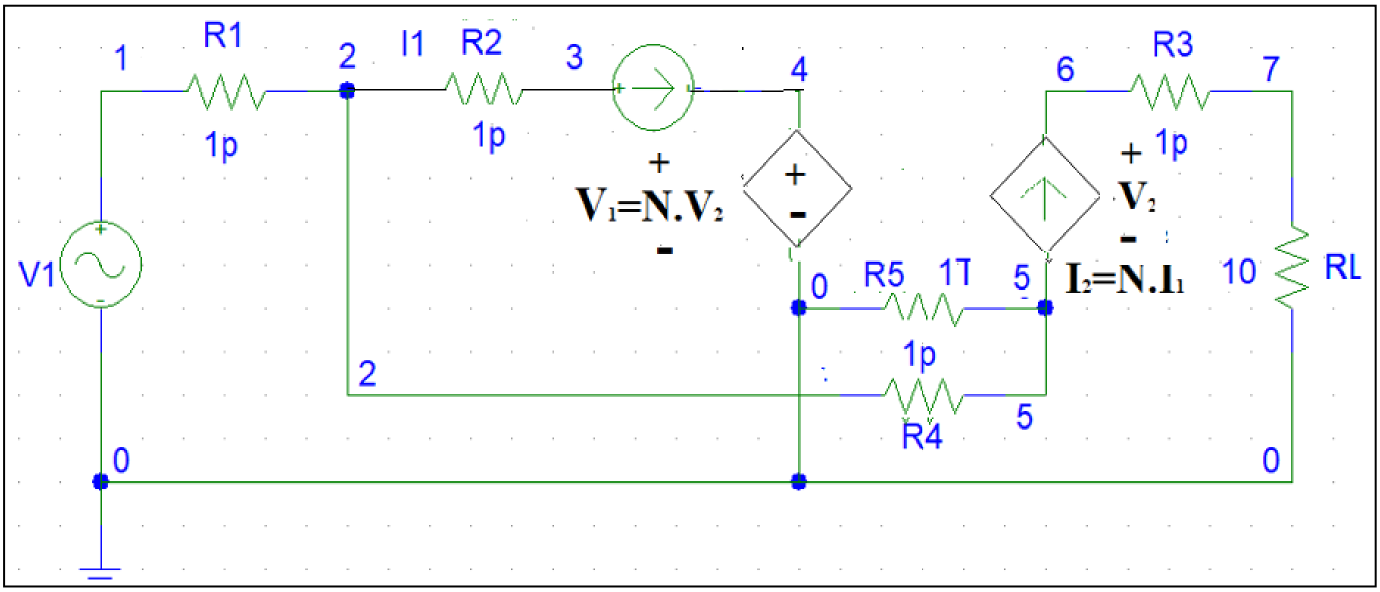

Fig 6b): In Figure 6.a, the Step-Up Autotransformer is Redrawn for PSpice Analysis

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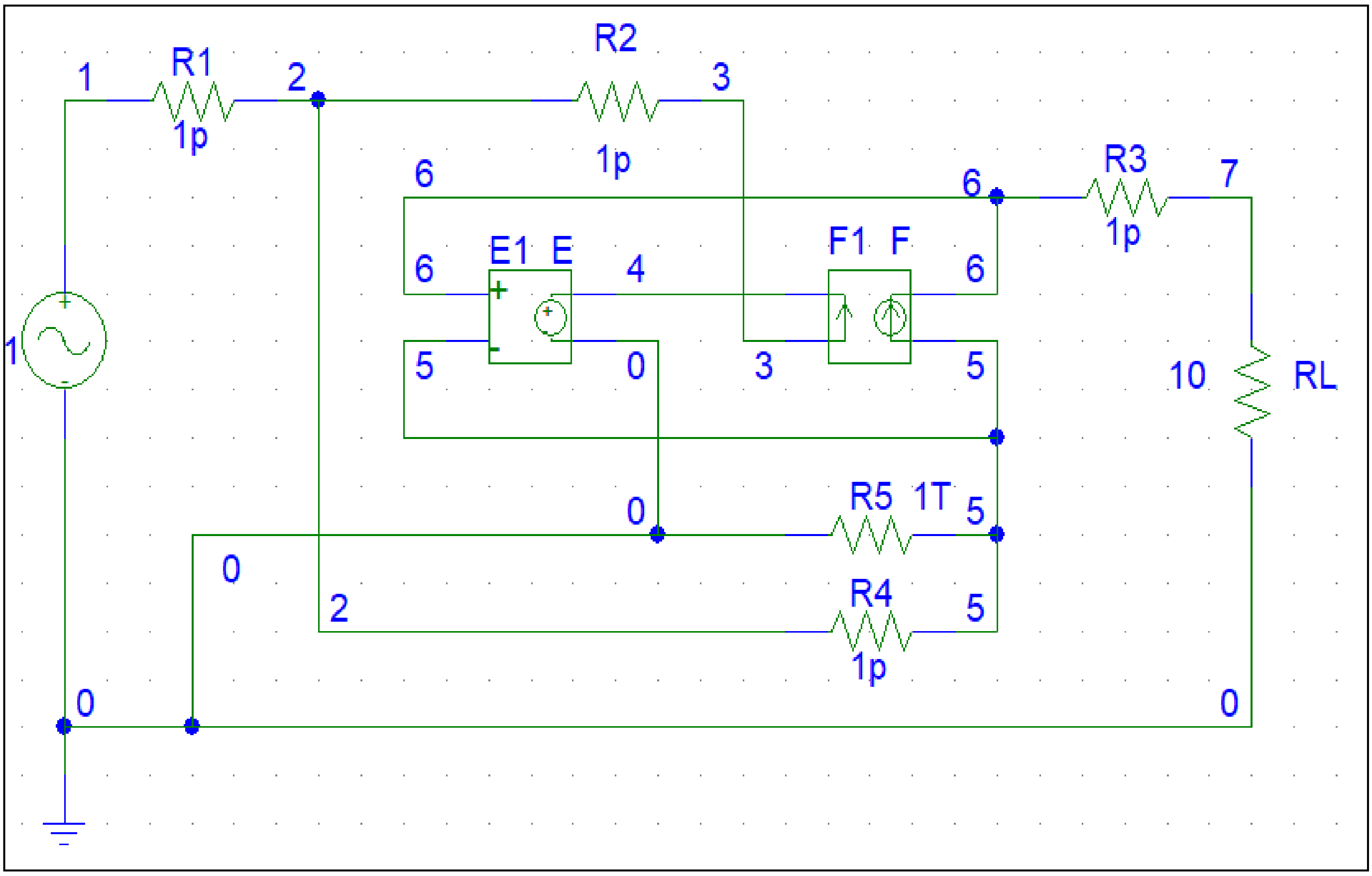

Fig 6c): The circuit diagram of Figure 6.b has been Redrawn for PSpice Schematic Analysis

The results that was obtained from the simulation of the stepup autotransformer calculated for Case Fig. 6.a.

$$\frac{V_1}{V_1+V_2} = \frac{N_1}{N_1+N_2} = \frac{1}{1+4} = \frac{1}{5}$$

$$V_2 = 4xV_1$$

$$V_1 = 2{,}75V = V_s$$

$$V_2 = 4xV_1 = 11V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_1-N_2}{+N_1}\right) = -\left(\frac{-1-4}{+1}\right) = \frac{5}{1}$$

$$I_1 = 5.I_2$$

$$I_2 = 0{,}2xI_1$$

$$I_2 = \frac{V_1+V_2}{R_L} = 1{,}375A$$

$$I_1 = 5xI_2 = 5x1{,}375 = 6{,}875A$$

$$I_x = I_1 - I_2 = 5{,}5A$$

$$P_s = V_sxI_1 = 2{,}75x6{,}875 = 18{,}90625W$$

$$P_s = R_LxI_2^2 = 10x1{,}375^2 = 18{,}90625W$$

$$P_{V1} = V_1xI_X = 2.75x5{,}5 = 15{,}125W$$

$$P_{V2} = V_2xI_2 = 11x1{,}375 = 15{,}125W$$

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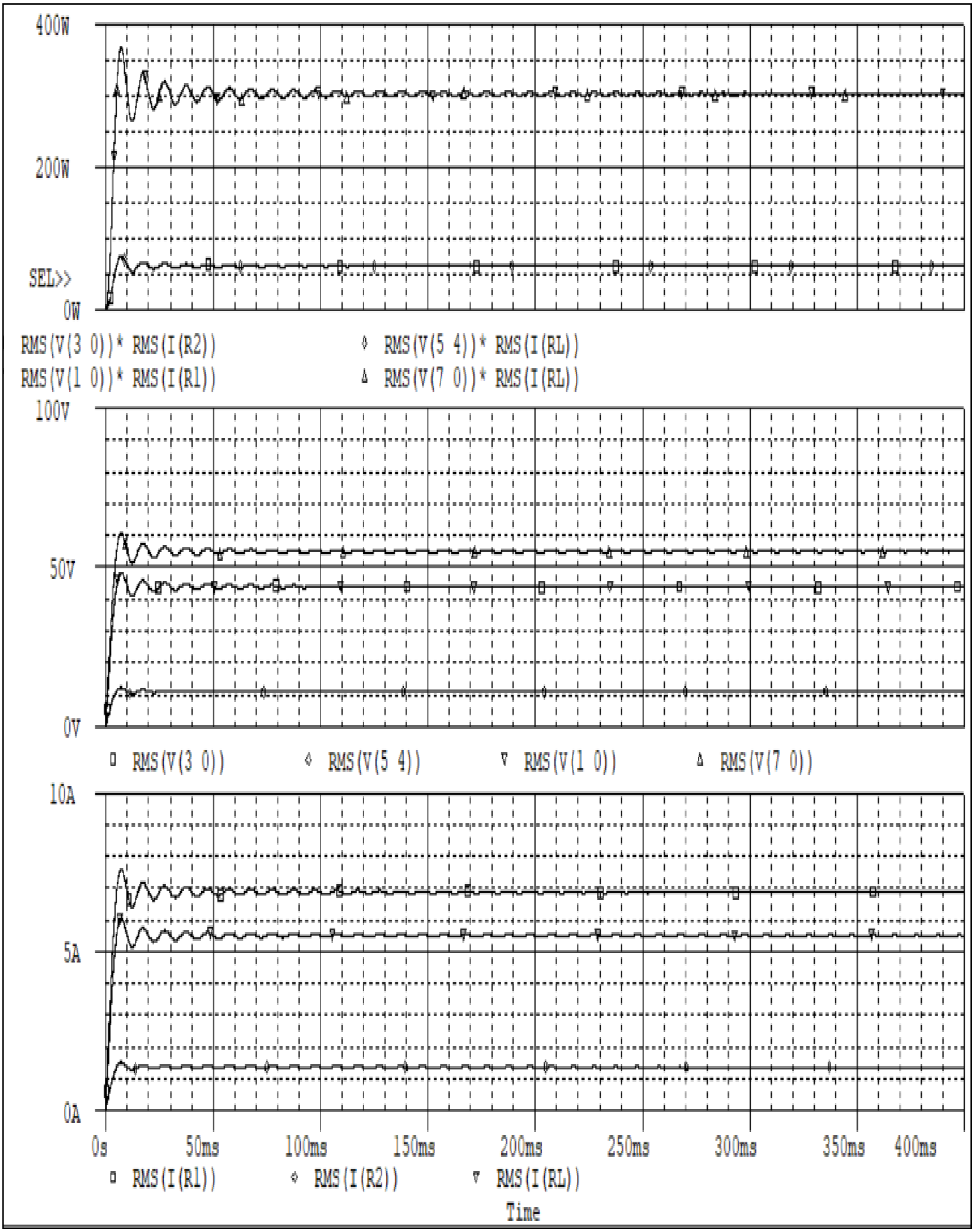

Fig 5d) PSpice plot of Voltages, Currents and Powers of Step-Up Autotransformer (Stepdown Transformer-A Step-Down Transformer is a Transformer where the Delivered Voltage is less than the Supplied Voltage) Case for Fig. 5-c

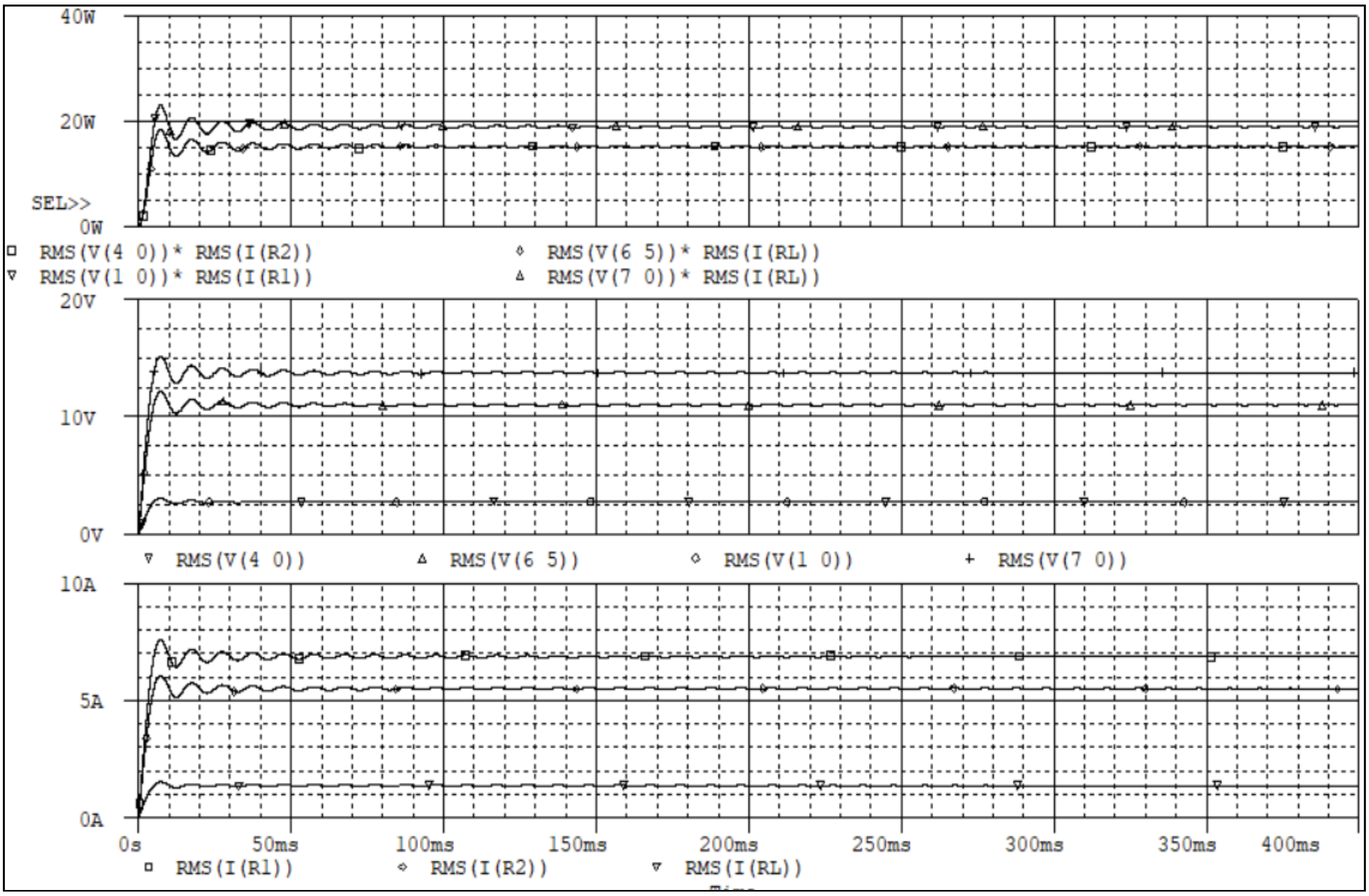

Fig 6d): PSpice Plot of Voltages, Currents and Powers of Step-Up Autotransformer (Stepup Transformer-A Step-Up Transformer is Transformer in Which Delivered Voltage is Higher than the Supplied Voltage.) Case for Fig. 6-c

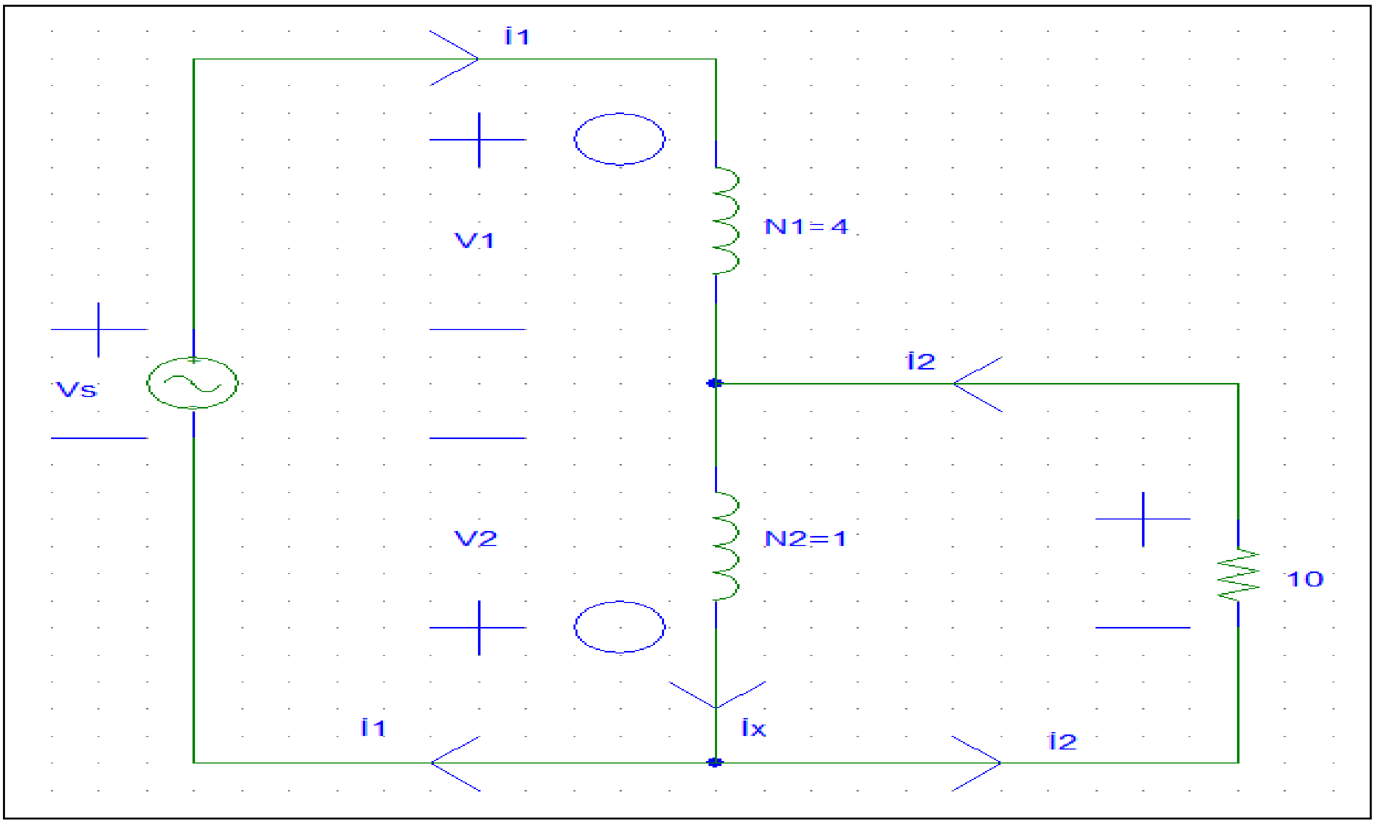

Fig 7a): The Circuit of the Step-Down Autotransformer

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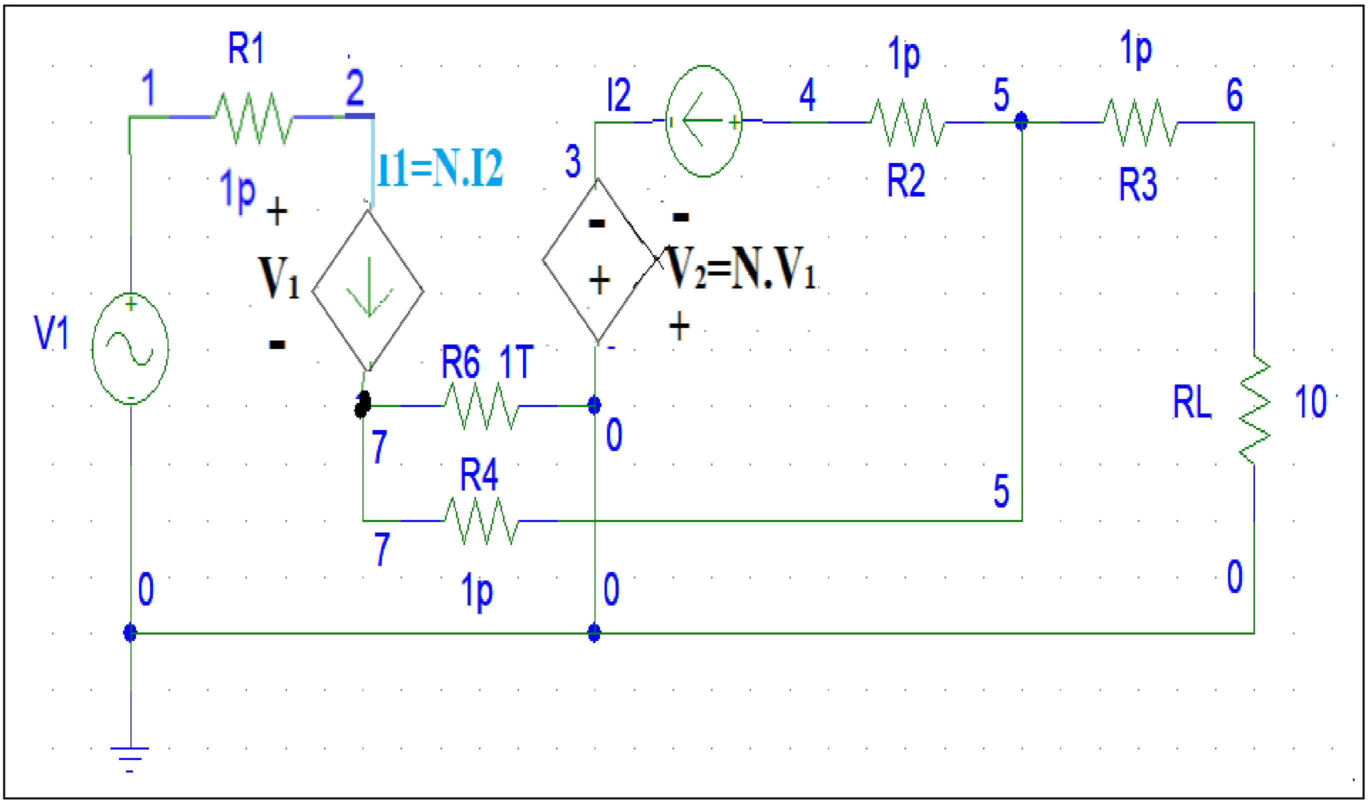

Fig 7b): In Figure 7.a, the Step-Down Autotransformer is Redrawn for PSpice Analysis

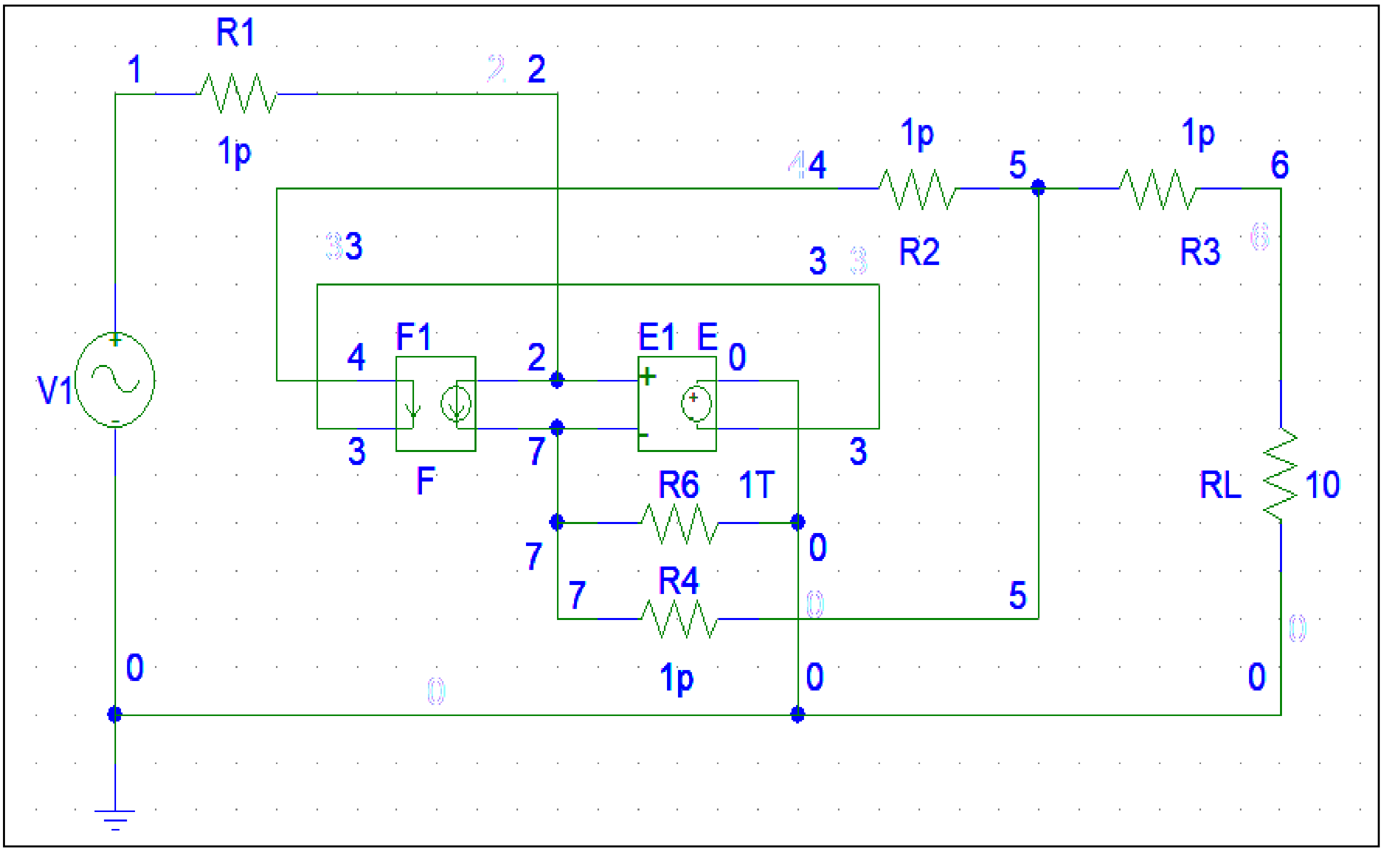

Fig 7): The Circuit Diagram of Figure 7.b has been Redrawn for PSpice Schematic Analysis

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

The Results that was Obtained from the Simulation of the Stepdown Autotransformer Calculated for Case Fig. 7.a..

$$\frac{V_1+V_2}{V_2}=\frac{N_1+N_2}{N_2}=\frac{4+1}{1}$$

$$V_1=4xV_2$$

$$V_1-V_2=123{,}75V$$

$$V_2=\frac{V_s}{3}=41{,}25V$$

$$V_1=4.V_2=165V$$

$$\frac{I_1}{I_2}=-\left(\frac{-N_2}{+N_1-N_2}\right)=-\left(\frac{-1}{+4-1}\right)=\frac{1}{3}$$

$$I_1=\frac{1}{3}xI_2$$

$$I_2=3xI_1$$

$$I_2=\frac{V_2}{10}=4{,}125A$$

$$I_1=\frac{1}{3}x4{,}125=1{,}375A$$

$$I_x=I_1+I_2=5{,}5A$$

$$P_s=V_sxI_1=123{,}75x1{,}375=170{,}156W$$

$$P_L=R_LxI_2^2=10x4{,}125^2=170{,}15625W$$

$$P_{V1}=V_1xI_1=165x1{,}375=226{,}875W$$

$$P_{V2}=V_2xI_x=41{,}25x5{,}5=226{,}875W$$

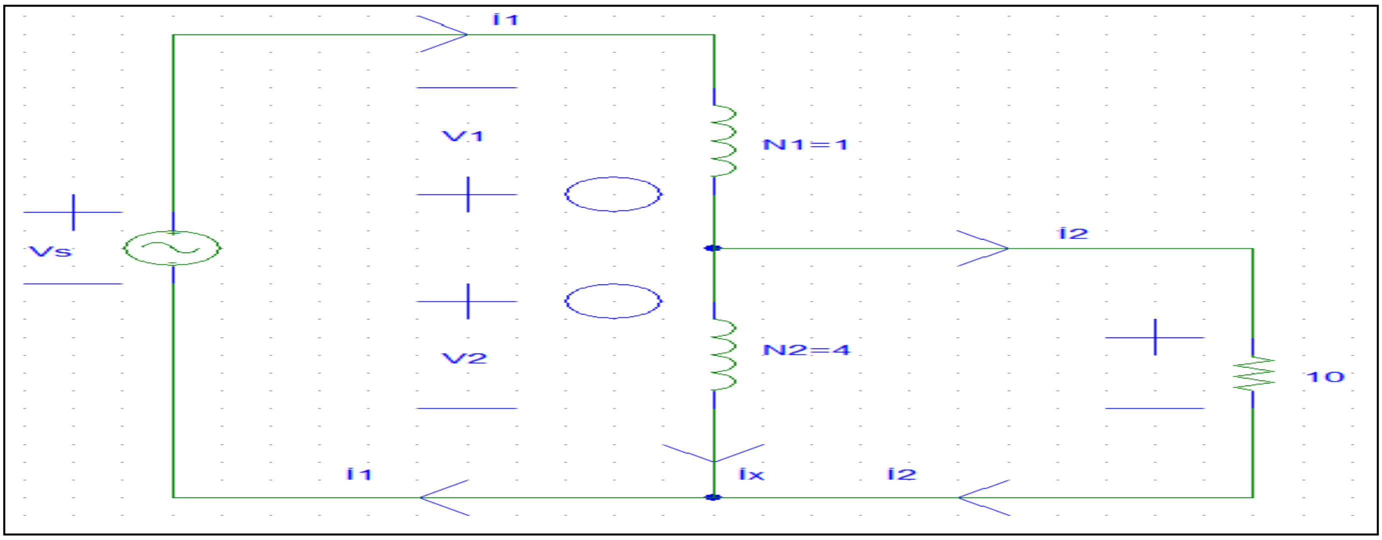

Fig 8a): The Circuit of the Step-Down Autotransformer

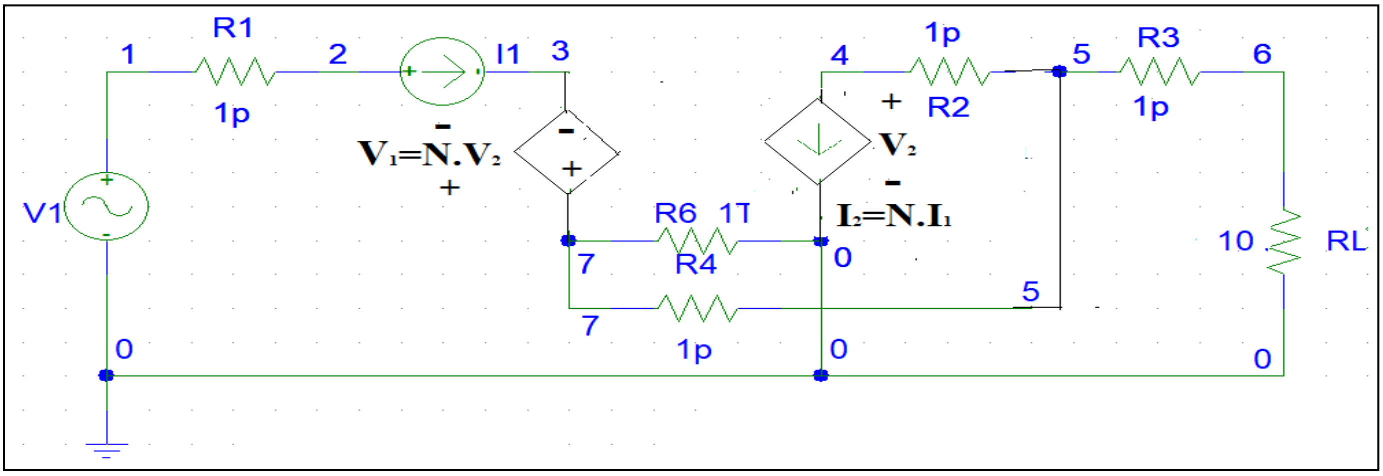

Fig 8b): In Figure 8.a, the Step-Down Autotransformer is Redrawn for PSpice Analysis

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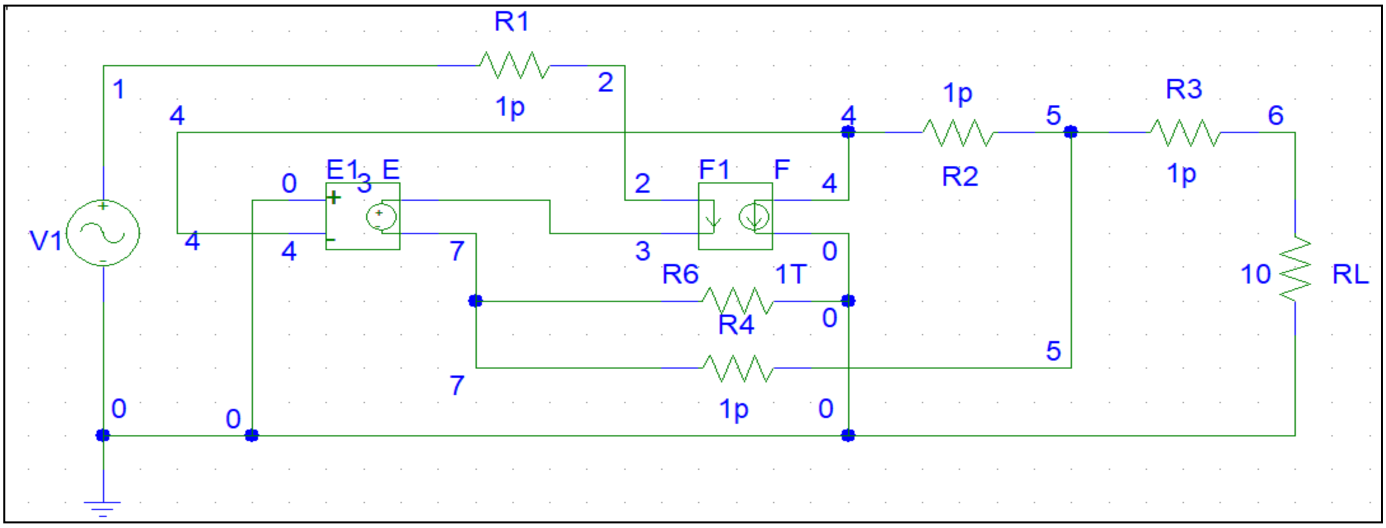

Fig 8c): The Circuit Diagram of Figure 8.b has been Redrawn for PSpice Schematic Analysis

The results that was obtained from the simulation of the stepup autotransformer calculated for Case Fig. 8.a.

$$\frac{V_1+V_2}{V_2} = \frac{N_1+N_2}{N_2} = \frac{1+4}{4}$$

$$V_2 = 4xV_1$$

$$-V_1 + V_2 = V_s$$

$$V_1 = \frac{V_s}{3} = 10{,}312V$$

$$V_2 = 4xV_1 = 41{,}25V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_2}{-N_1+N_2}\right) = -\left(\frac{-4}{-1+4}\right) = \frac{4}{3}$$

$$I_1 = 1{,}33xI_2$$

$$I_2 = 0{,}75xI_1$$

$$I_2 = \frac{V_2}{10} = \frac{41{,}25}{10} = 4{,}125A$$

$$I_1 = 1{,}33xI_2 = 5{,}5A$$

$$I_x = I_1 - I_2 = 1{,}375A$$

$$P_s = V_sxI_1 = 30{,}9375x5{,}5 = 170{,}1562W$$

$$P_L = R_LxI_2^2 = 10x4{,}125^2 = 170{,}15625W$$

$$P_{V1} = V_1xI_1 = 10{,}3125x5{,}5 = 56{,}7187W$$

$$P_{V2} = V_2xI_x = 41{,}25x1{,}375 = 56{,}718W$$

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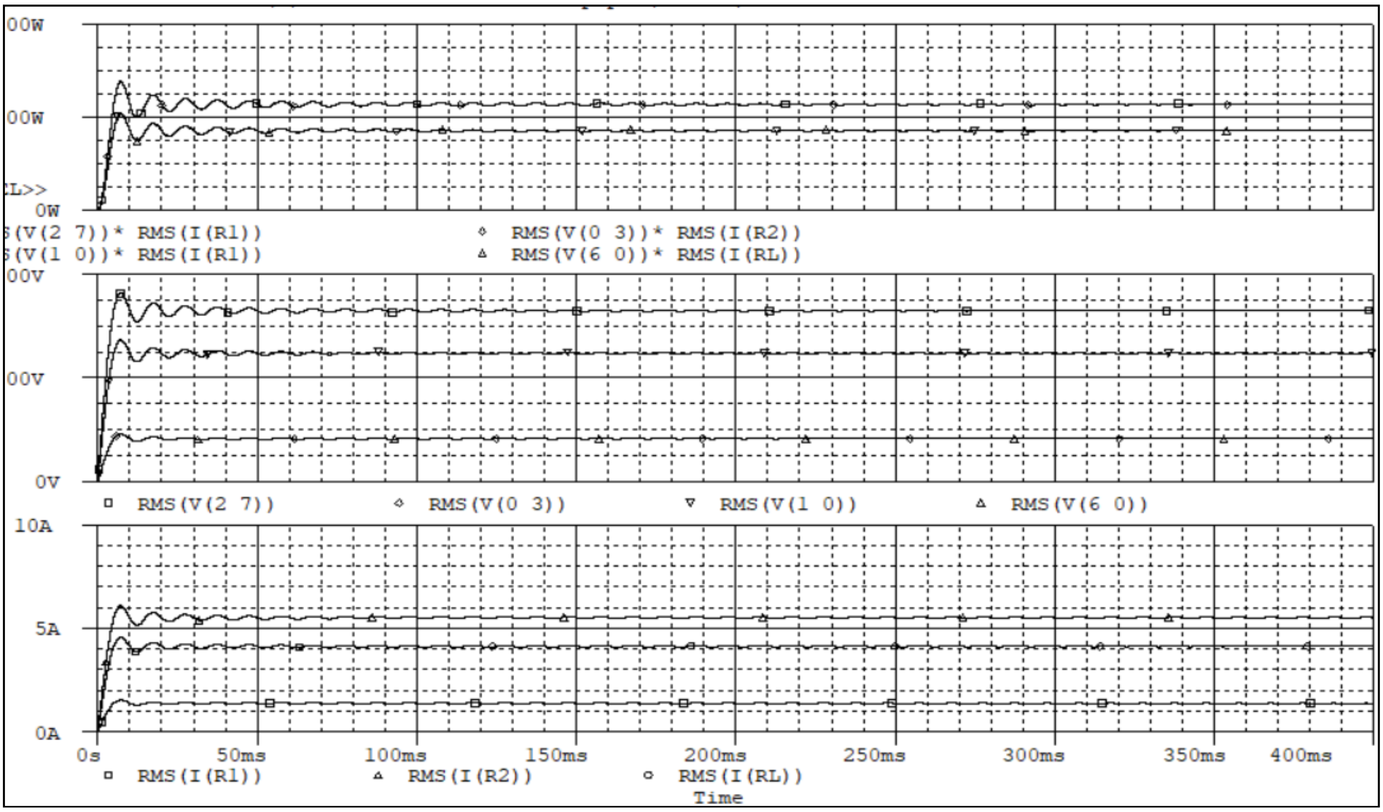

Fig 7d): PSpice Plot of Voltages, Currents and Powers of Step-Down Autotransformer (Stepdown Transformer-A Step-Down Transformer is a Transformer Where the Delivered Voltage is Less than the Supplied Voltage) Case for Fig. 7-c

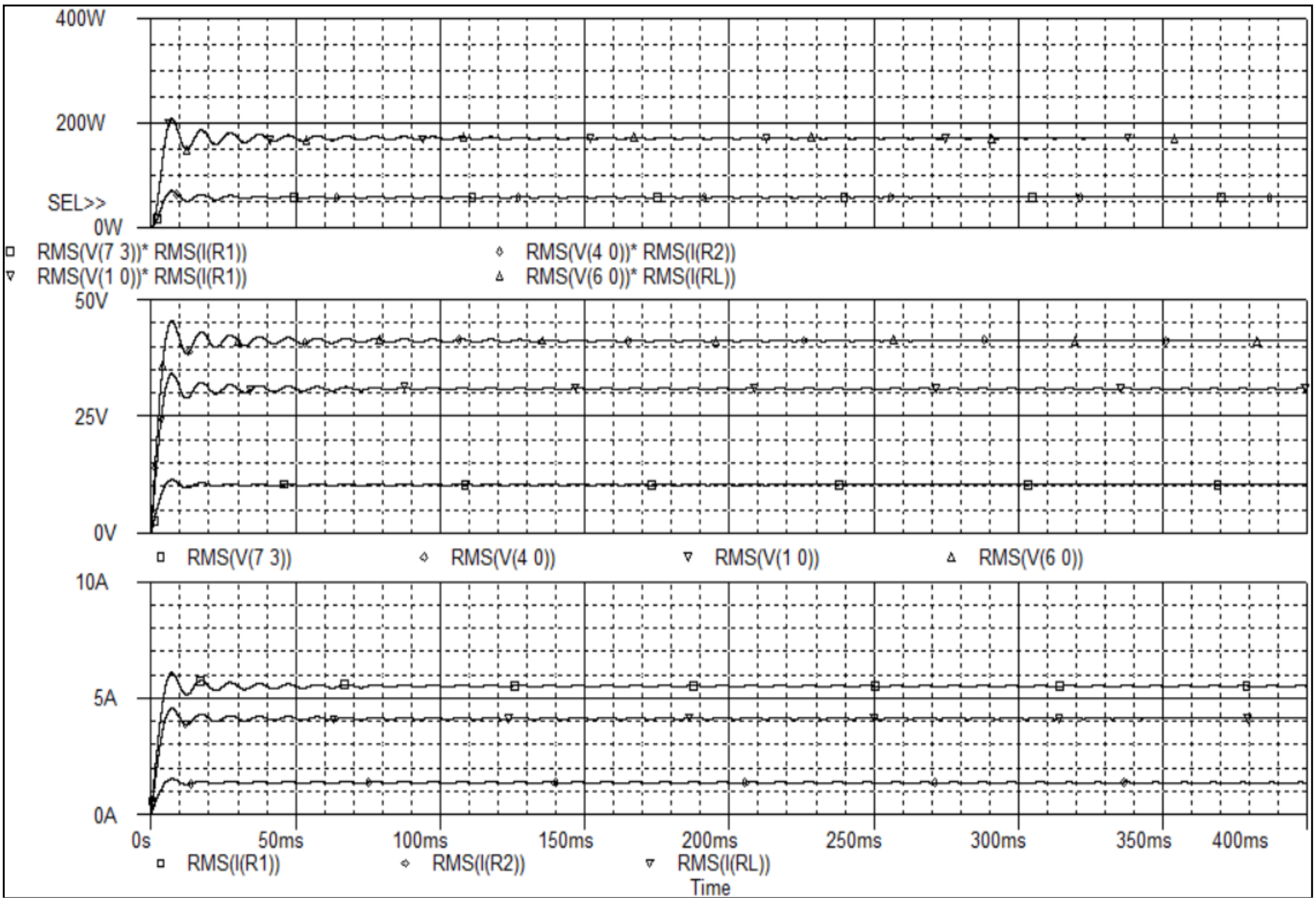

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Fig 8d): PSpice Plot of Voltages, Currents and Powers of Step-Down Autotransformer (Stepup Transformer-A Step-Up Transformer is Transformer in which Delivered Voltage is Higher than the Supplied Voltage.) Case for Fig. 8-c

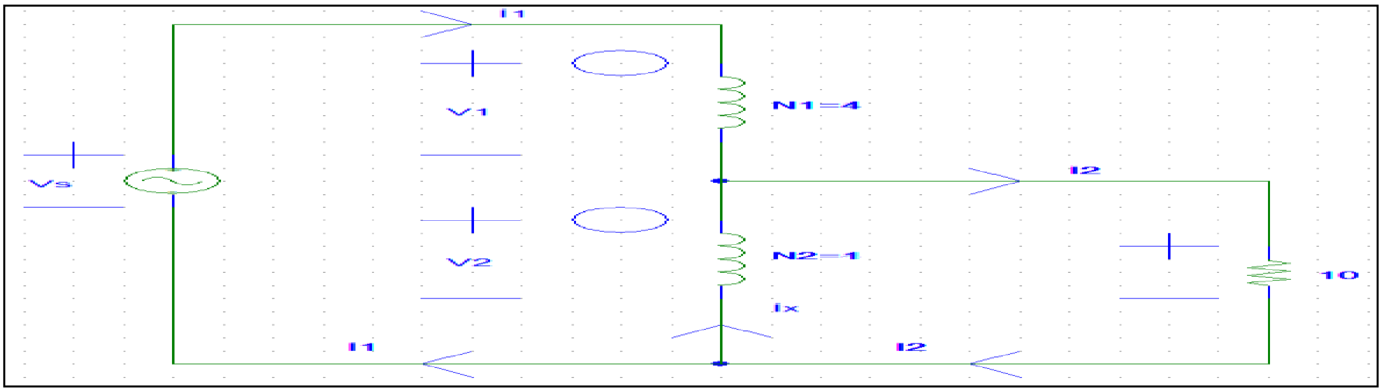

Fig 9a): The circuit of the Step-Down Autotransformer

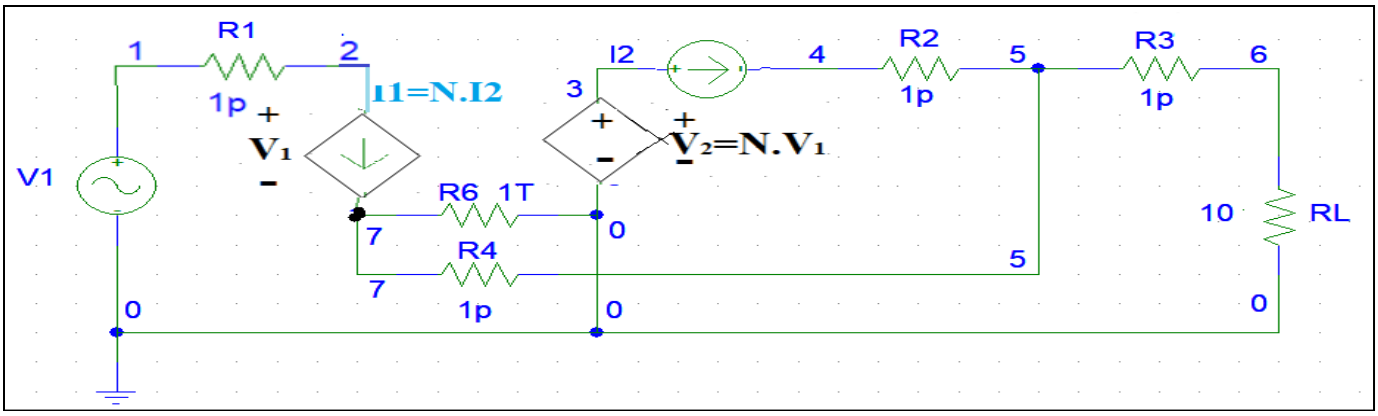

Fig 9b): In Figure 9.a, the Step-Down Autotransformer is Redrawn for PSpice Analysis

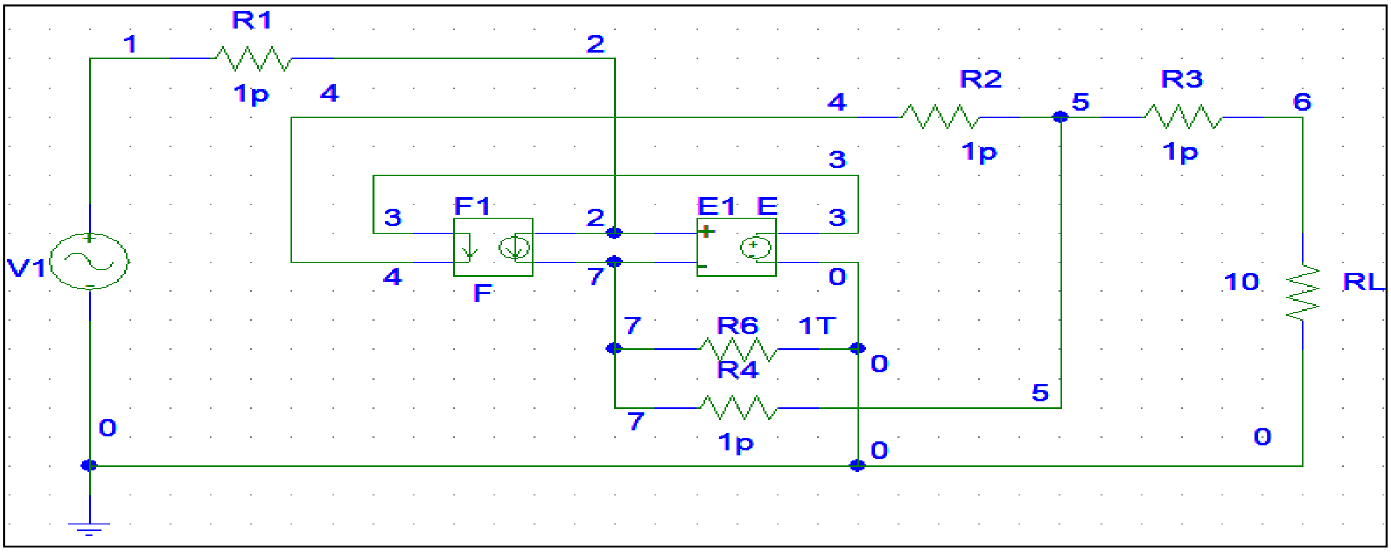

Fig 9c): The Circuit Diagram of Figure 3.b has been Redrawn for PSpice Schematic Analysis

- *The Results that was Obtained from the Simulation of the Stepdown Autotransformer Calculated for Case Fig. 9.A.*

$$\frac{V_1+V_2}{V_2} = \frac{N_1+N_2}{N_2} = \frac{4+1}{1}$$

$$V_1 = 4xV_2$$

$$V_1 + V_2 = 220V$$

$$V_2 = \frac{V_s}{5} = 44V$$

$$V_1 = 4xV_2 = 176V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_2}{+N_1+N_2}\right) = -\left(\frac{-1}{+4+1}\right) = \frac{1}{5}$$

$$I_1 = 0{,}2xI_2$$

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

$I_2 = 5xI_1$

$I_2 = \frac{V_2}{10} = 4{,}4A$

$I_1 = 0{,}2xI_2 = 0{,}88A$

$I_x = I_2 - I_1 = 3{,}52A$

$P_s = V_s x I_1 = 220x0{,}88 = 193{,}6W$

$P_L = R_L x I_2^2 = 10x4{,}4^2 = 193{,}6W$

$P_{V1} = V_1 x I_1 = 176x0{,}88 = 154{,}88W$

$P_{V2} = V_2 x I_x = 44x3{,}52 = 154{,}88W$

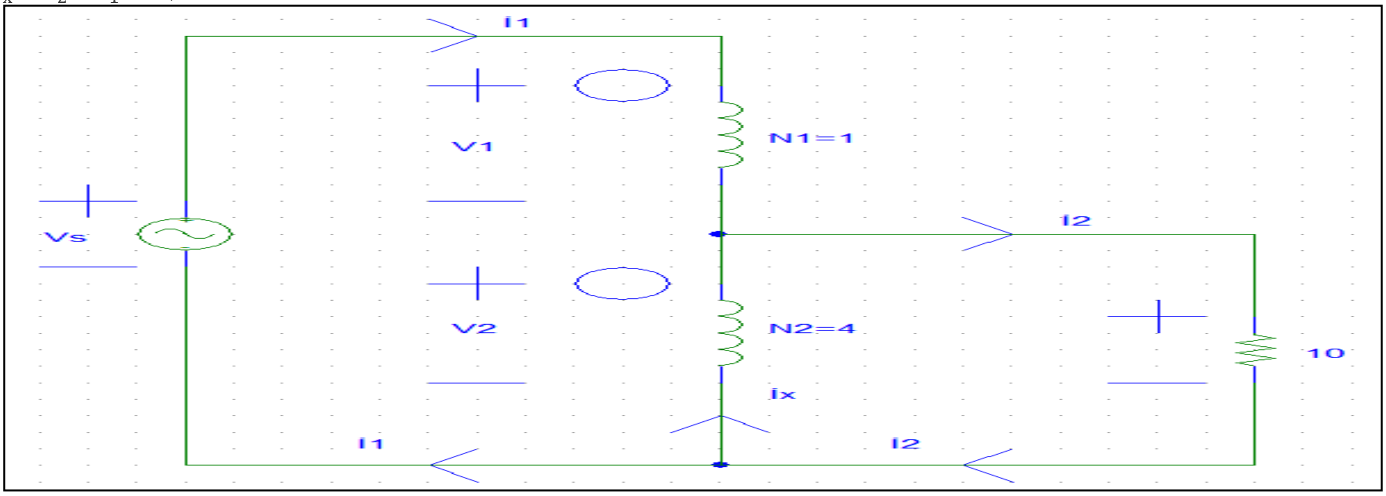

Fig 10a): The Circuit of the Step-Down Autotransformer

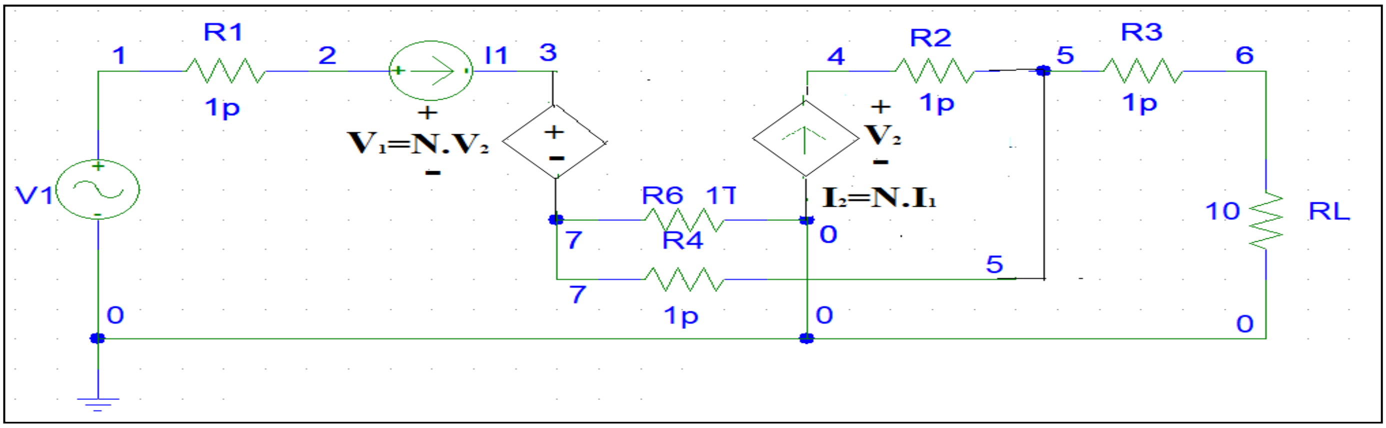

Fig 10b): In Figure 10.a, the Step-Down Autotransformer is Redrawn for PSpice Analysis

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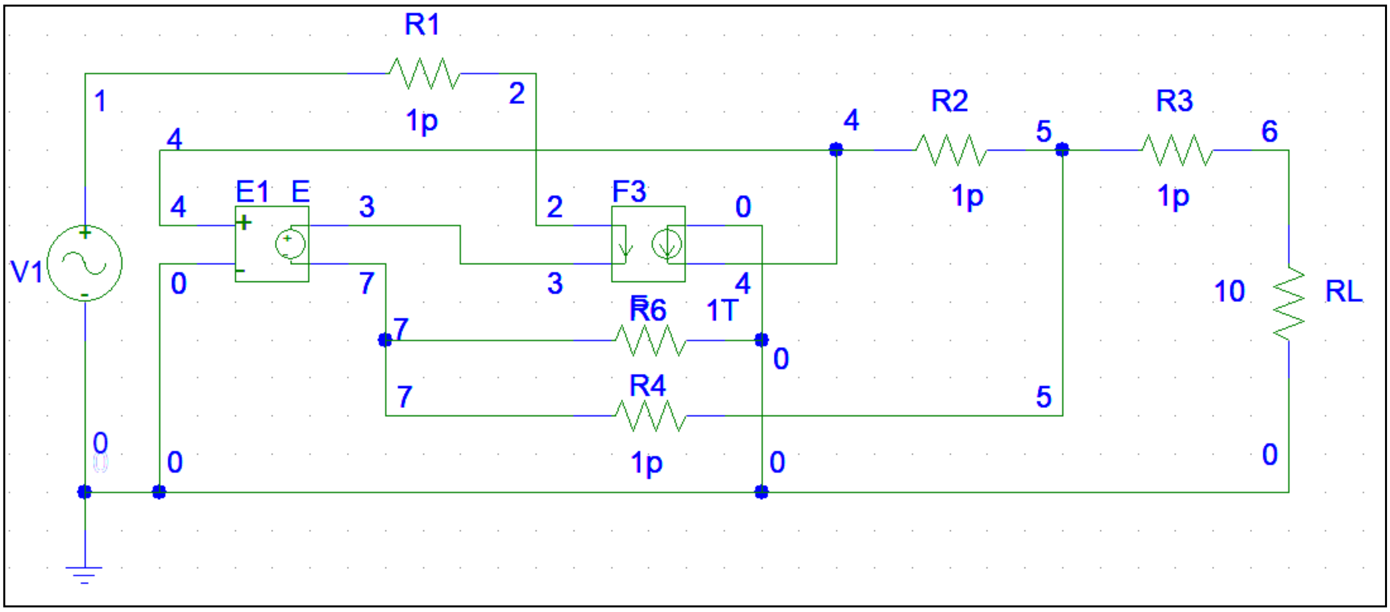

Fig 10d): The Circuit Diagram of Figure 3.b has been Redrawn for PSpice Schematic Analysis

The results that was obtained from the simulation of the step down autotransformer calculated for Case Fig.10.a.

$$\frac{V_1+V_2}{V_2} = \frac{N_1+N_2}{N_2} = \frac{1+4}{4}$$

$$V_2 = 4xV_1$$

$$V_1 + V_2 = 85{,}937$$

$$V_1 = \frac{V_s}{5} = 17{,}187V \quad V_2 = 4xV_1 = 68{,}75V$$

$$\frac{I_1}{I_2} = -\left(\frac{-N_2}{+N_1+N_2}\right) = -\left(\frac{-4}{+1+4}\right) = \frac{4}{5}$$

$$I_1 = 0{,}8xI_2$$

$$I_2 = 1{,}25xI_1$$

$$I_2 = \frac{V_2}{10} = \frac{68{,}75}{10} = 6{,}875A$$

$$I_1 = 0{,}8.I_2 = 5{,}5A$$

$$I_x = I_2 - I_1 = 1{,}375A$$

$$P_s = V_s xI_1 = 85{,}937x5{,}5 = 472{,}65625W$$

$$P_s = R_L xI_2^2 = 10x1{,}375^2 = 472{,}65625W$$

$$P_{V1} = V_1 xI_1 = 17{,}187x5{,}5 = 94{,}53125W$$

$$P_{V2} = V_2 xI_x = 68{,}75x1{,}375 = 94{,}5312W$$

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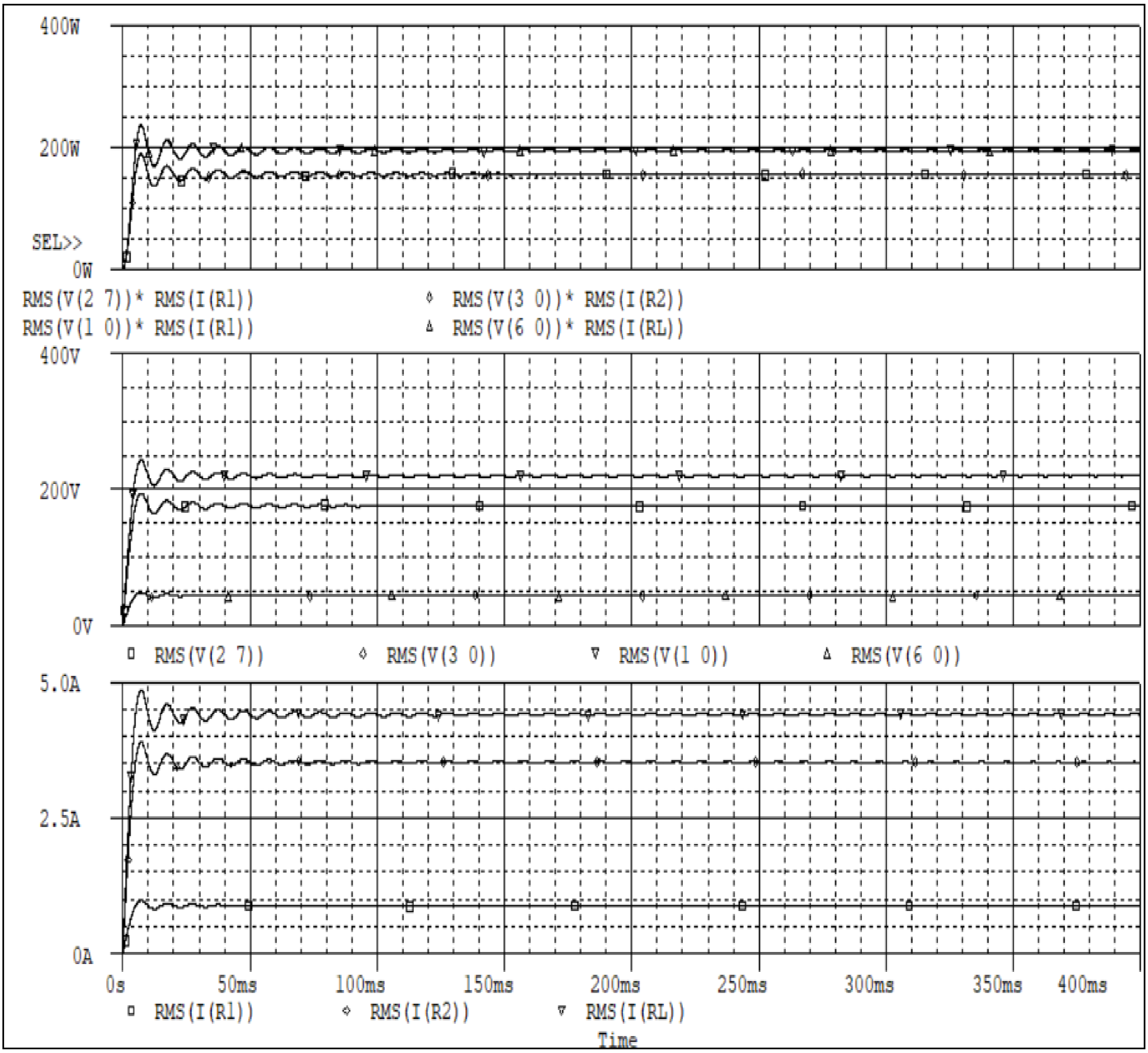

Fig 9d): PSpice Plot of Voltages, Currents and Powers of Step-Down Autotransformer (Stepdown Transformer-A Step-Down Transformer is a Transformer where the Delivered Voltage is Less than the Supplied Voltage) Case for Fig. 9-c

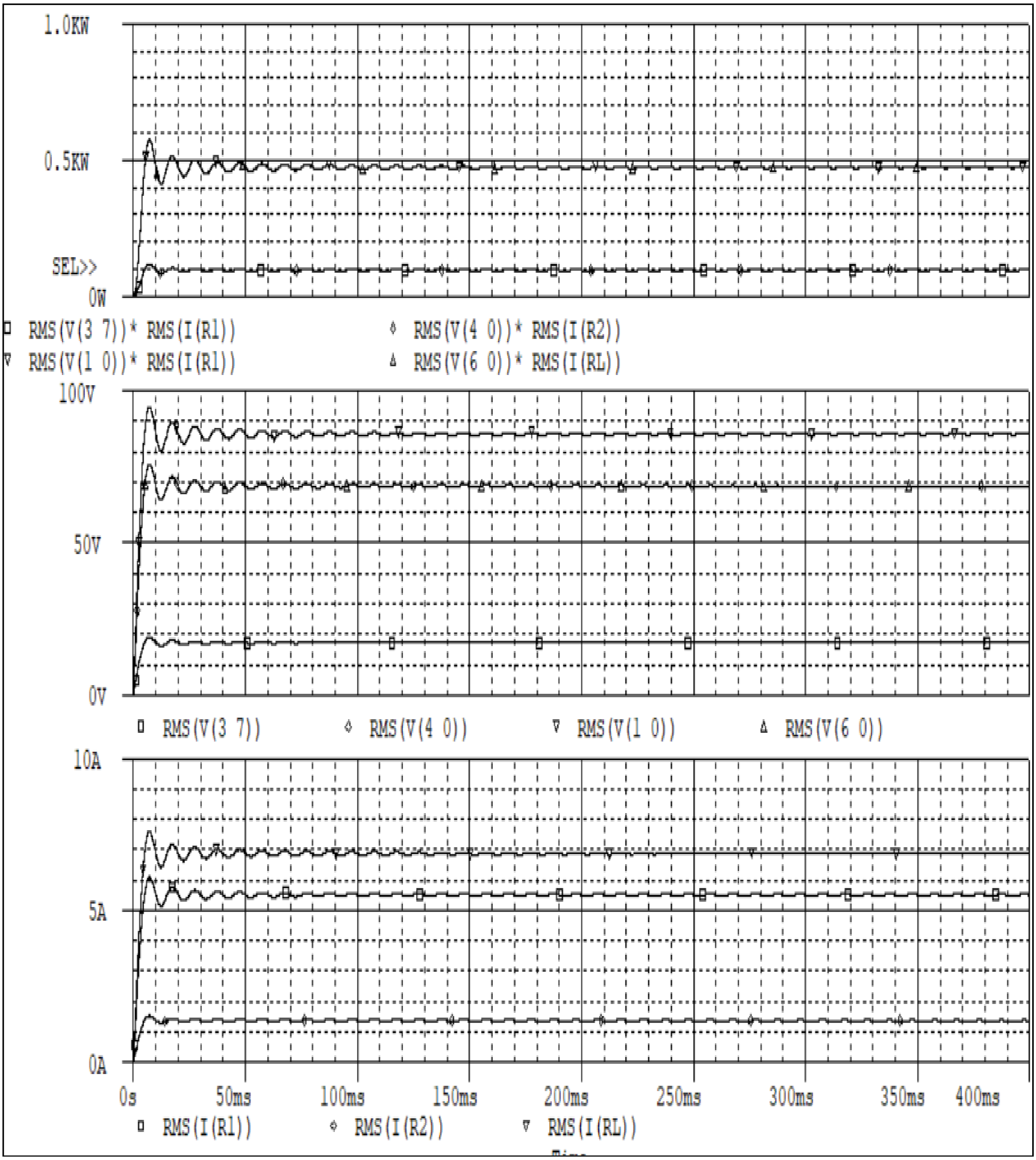

Fig 10d) PSpice plot of Voltages, Currents and Powers of Step-Down Autotransformer (Stepup Transformer- A Step-Up Transformer is Transformer in which Delivered Voltage is Higher than the Supplied Voltage.) Case for Fig. 10-

IV. CONCLUSION

Fig. 3.c, Fig. 4.c, Fig. 5.c and Fig. 6.c stepup autotransformer and Fig. 7.c, Fig. 8.c, Fig. 9.c and 10.c stepdown autotransformer show PSpice simulation schematics and results of previously mention mathematical models of step-up and step-down autotransformers. As it can be seen clearly the mathematical models are validated by simulations. From the analytical and simulation results, the voltages Vs, V1, V2 and VRL for a step-down and step-up autotransformer with different voltage polarity and different types of current circuits, the analytical results of the currents I1, I2, Ix, Pv1, Pv2 and Ps, PRL are different, as well as the analytical results of the modeling. The results are verified by the simulation result.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAY393

Additionally, an easy-to-install step-down and step-up circuits are proposed to verify the analytical results. To the practical nominal power of the autotransformer, step-down transformer primary current = 1.325 A, transformer secondary current = 5.5 A and step-up transformer primary current = 5.5 A, transformer secondary current = 1.375 A. To obtain these results, the transformer's input voltage, input current and primary power reduced.

➢ *According to the Analysis and Simulation Fig. 1.*

- $P_s = V_s x I_1 = 220x1{,}375 = 302{,}5W$
- $P_L = R_L x I_2^2 = 10x5{,}5^2 = 302{,}5W$
- $P_{V1} = V_1 x I_1 = 220x1{,}375 = 302{,}5W$
- $P_{V2} = V_2 x I_2 = 55x5{,}5 = 302{,}5W$

➢ *According to the Analysis and Simulation Fig. 2.*

- $P_s = V_s x I_1 = 3{,}4375x5{,}5 = 18{,}90625W$
- $P_L = R_L x I_2^2 = 10x1{,}375^2 = 18{,}90625W$
- $P_{V1} = V_1 x I_X = 3{,}4375x5{,}5 = 18{,}90625W$
- $P_{V2} = V_2 x I_2 = 13{,}75x1{,}375 = 18{,}90625W$

➢ *According to the Analysis and Simulation Fig. 3.*

- $P_s = V_s x I_1 = 73.33x4{,}125 = 302{,}5W$
- $P_L = R_L x I_2^2 = 10x4{,}125^2 = 302{,}5W$
- $P_{V1} = V_1 x I_X = 73{,}33x1{,}375 = 100{,}833W$
- $P_{V2} = V_2 x I_2 = 18{,}33x5{,}5 = 100{,}833W$

➢ *According to the Analysis and Simulation Fig. 4.*

- $P_s = V_s x I_1 = 4{,}583x4{,}125 = 18{,}90625W$
- $P_L = R_L x I_2^2 = 10x1{,}375^2 = 18{,}90625W$
- $P_{V1} = V_1 x I_X = 4{,}5833x5{,}5 = 25{,}2083W$
- $P_{V2} = V_2 x I_2 = 18{,}333x1{,}375 = 25{,}2083W$

➢ *According to the Analysis and Simulation Fig.5.*

- $P_s = V_s x I_1 = 44x6{,}875 = 302{,}5W$
- $P_L = R_L x I_2^2 = 10x5{,}5^2 = 302{,}5W$
- $P_{V1} = V_1 x I_X = 44x1{,}375 = 60{,}5W$
- $P_{V1} = V_2 x I_2 = 11x5{,}5 = 60{,}5W$

➢ *According to the Analysis and Simulation Fig. 6.*

- $P_s = V_s x I_1 = 2{,}75x6{,}875 = 18{,}90625W$
- $P_s = R_L x I_2^2 = 10x1{,}375^2 = 18{,}90625W$
- $P_{V1} = V_1 x I_X = 2.75x5{,}5 = 15{,}125W$
- $P_{V2} = V_2 x I_2 = 11x1{,}375 = 15{,}125W$

➢ *According to the Analysis and Simulation Fig. 7*

- $P_s = V_s x I_1 = 123{,}75x1{,}375 = 170{,}156W$
- $P_L = R_L x I_2^2 = 10x4{,}125^2 = 170{,}15625W$
- $P_{V1} = V_1 x I_1 = 165x1{,}375 = 226{,}875W$
- $P_{V2} = V_2 x I_x = 41{,}25x5{,}5 = 226{,}875W$

➢ *According to the Analysis and Simulation Fig. 8.*

$P_s = V_s x I_1 = 30{,}9375x5{,}5 = 170{,}1562W$
$P_L = R_L x I_2^2 = 10x4{,}125^2 = 170{,}15625W$
$P_{V1} = V_1 x I_1 = 10{,}3125x5{,}5 = 56{,}7187W$
$P_{V2} = V_2 x I_x = 41{,}25x1{,}375 = 56{,}718W$

➢ *According to the Analysis and Simulation Fig. 9.*

$P_s = V_s x I_1 = 220x0{,}88 = 193{,}6W$
$P_L = R_L x I_2^2 = 10x4{,}4^2 = 193{,}6W$
$P_{V1} = V_1 x I_1 = 176x0{,}88 = 154{,}88W$
$P_{V2} = V_2 x I_x = 44x3{,}52 = 154{,}88W$

➢ *According to the Analysis and Simulation Fig.10.*

$P_s = V_s x I_1 = 85{,}937x5{,}5 = 472{,}65625W$
$P_s = R_L x I_2^2 = 10x1{,}375^2 = 472{,}65625W$
$P_{V1} = V_1 x I_1 = 17{,}187x5{,}5 = 94{,}53125W$
$P_{V2} = V_2 x I_x = 68{,}75x1{,}375 = 94{,}5312W$

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