

ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 2: To understand the principle of turn ratio of a transformer

Introduction

A transformer is a static device which transfers electrical energy from one circuit to another with no direct electrical connection between the two but they are magnetically coupled. It transforms power from one circuit to another without changing its frequency and KVA. A transformer can increase or decrease the voltage with corresponding decrease or increase in current. It helps in providing isolation of the secondary side from the primary side and hence provides safety for the person handling it on the load side.

Turn Ratio

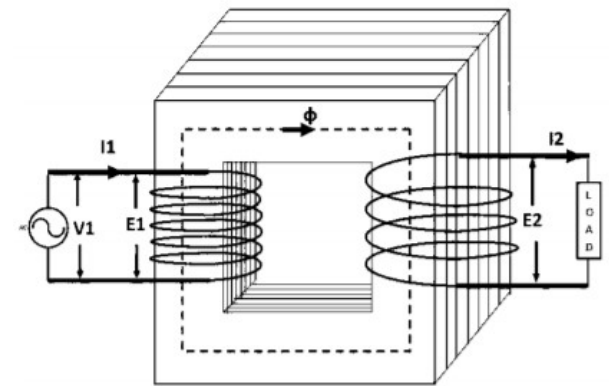
It is defined as the ratio of primary to secondary turns.

$$\text{Turns Ratio} = N_1 / N_2$$

If $N_2 > N_1$ the transformer is called Step up transformer

If $N_2 < N_1$ the transformer is called Step down transformer

If $N_2 = N_1$ the transformer is called Isolation transformer



Transformer setting calculation

As you know that
In Ideal T/F

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

$$V_2 = V_1 \times \frac{N_2}{N_1}$$

But actually there is a coupling factor
and $N \propto \sqrt{L}$

$$V_2 = V_1 \times C_p \times \frac{N_2}{N_1}$$

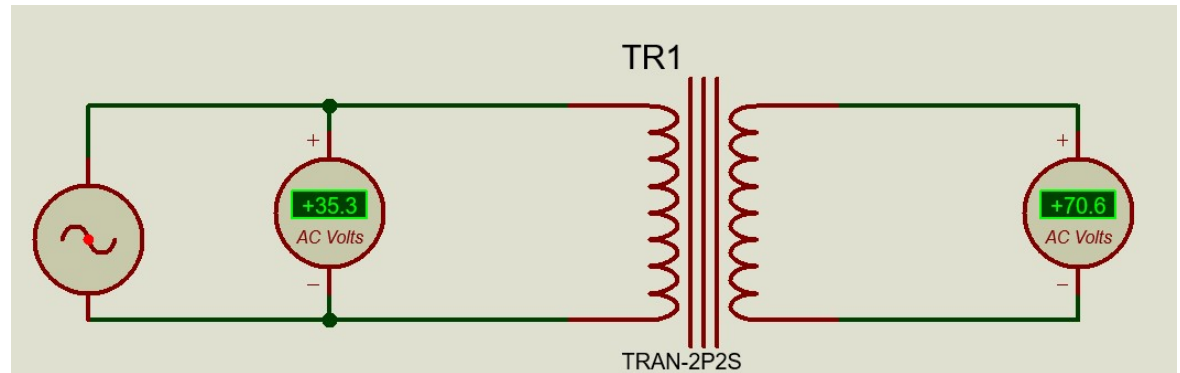
$$V_2 = V_1 \times C_p \times \sqrt{\frac{L_2}{L_1}}$$

For step up t/f $V_2 = 100V$
 $V_1 = 50V$

$$V_2 = V_1 \times C_p \times \sqrt{\frac{L_2}{L_1}}$$

$$\sqrt{\frac{L_2}{L_1}} = 2 \quad \left| \quad \begin{array}{l} L_2 = 4mH \\ L_1 = 1mH \end{array} \right.$$

$$\sqrt{4} = 2$$



Edit Component

Part Reference: Hidden: ☐

Part Value: Hidden: ☐

Element: New

Primary Inductance: Hide All

Secondary Inductance: Hide All

Coupling Factor: Hide All

Primary DC resistance: Hide All

Secondary DC resistance: Hide All

Other Properties:

☐ Exclude from Simulation ☐ Attach hierarchy module

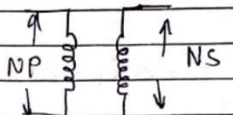
☐ Exclude from PCB Layout ☐ Hide common pins

☐ Exclude from Current Variant ☐ Edit all properties as text

OK Cancel

Transformer setting calculation

If T/f is with tapping and $C_p = 100\%$
 at 100% tapping $N_p = N_s$
 let assume $N_p = 100$
 $N_s = 100$



We have four tapping at secondary

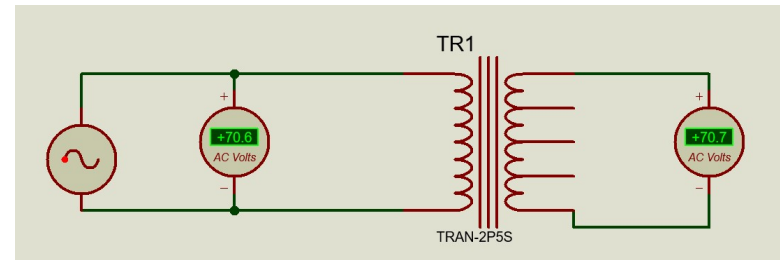
$$N_{s1} = N_{s2} = N_{s3} = N_{s4} = \frac{100}{4} = 25$$

Now calculate inductance b/w each tapping

$$\frac{L_{s1} + L_{s2} + L_{s3} + L_{s4}}{L_p} = \frac{N_{s1}^2 + N_{s2}^2 + N_{s3}^2 + N_{s4}^2}{N_p^2}$$

$$= \frac{(25)^2 \times 4}{(100)^2} = \frac{1}{4}$$

If $L_p = 4\text{mH}$
 then $L_{s1} = 1/4\text{mH} = 0.25\text{mH}$



Edit Component

Part Reference: Hidden: ☐

Part Value: Hidden: ☐

Element: New

Primary Inductance: Hide All

S1-S2 Secondary Inductance: Hide All

S2-S3 Secondary Inductance: Hide All

S3-S4 Secondary Inductance: Hide All

S4-S5 Secondary Inductance: Hide All

Coupling Factor: Hide All

Primary DC resistance: Hide All

Secondary DC resistance: Hide All

Other Properties:

☐ Exclude from Simulation ☐ Attach hierarchy module

☐ Exclude from PCB Layout ☐ Hide common pins

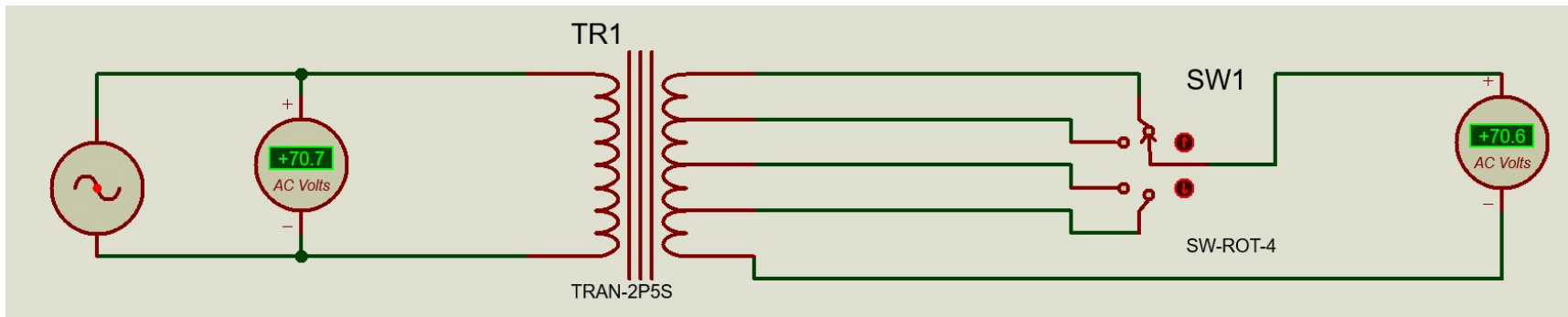
☐ Exclude from Current Variant ☐ Edit all properties as text

OK Cancel

Observation and Calculation

S.No.	V1	V2	N1	N2	Turns ratio

Simulation Diagram



Thanks You