Department of CSE

CSE209 Lab

Course Name: Electrical Circuits

Course Code: CSE209

Section No: 2

Name of the Project: PSpice Analysis for Maximum Power Transfer.

Date of submission: 11/09/2021

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Objectives:

1. To verify Thevenin's equivalent of the circuit theoretically, and using PSpice simulation.
2. To analyze and verify maximum power transfer theorem of the circuit theoretically and using PSpice simulation by resistance sweeping.

Step 1:

1. Using PSpice Simulation, determine the Thevenin's equivalent of the circuit looking from the load resistance $R_{L.}$

Circuit Diagram(s):

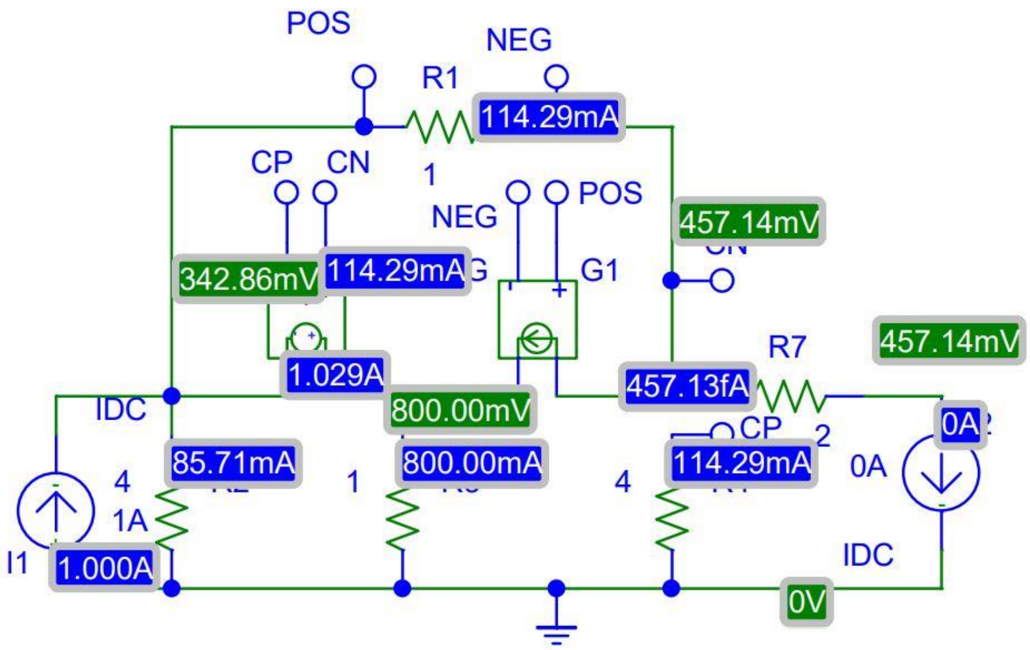

Figure 1.PSpice Schematic circuit diagram for V_{OC}

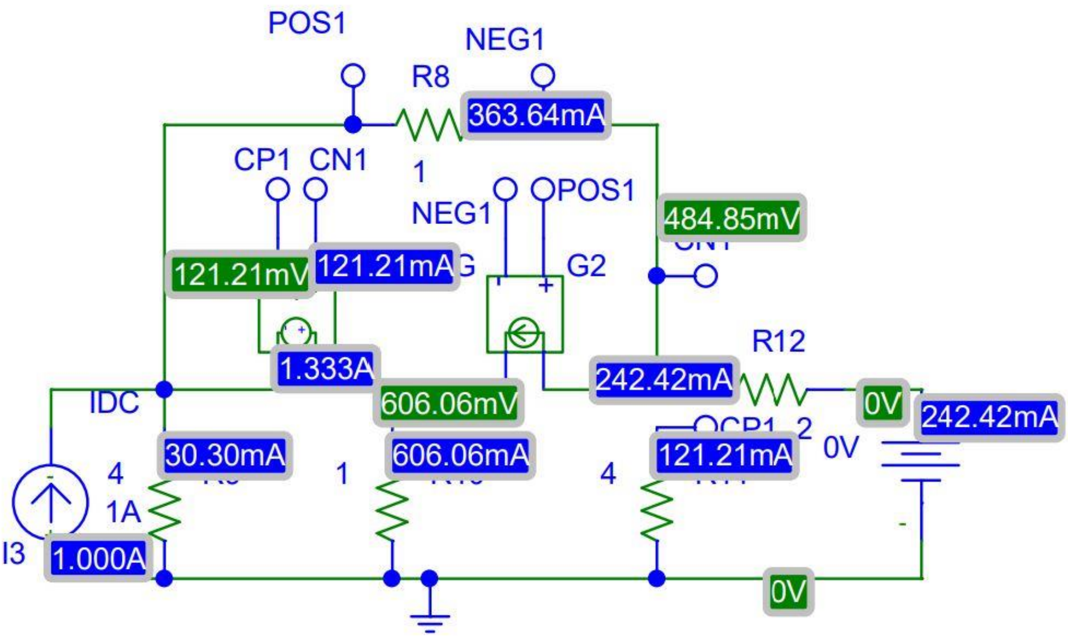

Figure 2.PSpice Schematic circuit diagram for I_{SC}

In circuit 1 and circuit 2 we create to calculate $R_{Th,}$ where V_{OC} =457.14V and I_{SC} =242.42mA.

$$\text{So,}R_L = R_{Th} = \frac{V_{OC}}{I_{SC}}$$

$$= \frac{457.14}{242.42}$$

$$R_{Th} = 1.89\Omega$$

Step 2:

2. From the Thevenin's equivalent circuit, theoretically determine the value of load resistance R_L for maximum power transfer. Using PSpice Simulation of the Thevenin's equivalent circuit with R_L for maximum power transfer, determine the value of maximum power transferred to R_L

Theoretical Calculation:

Calculation for R_{Th} :

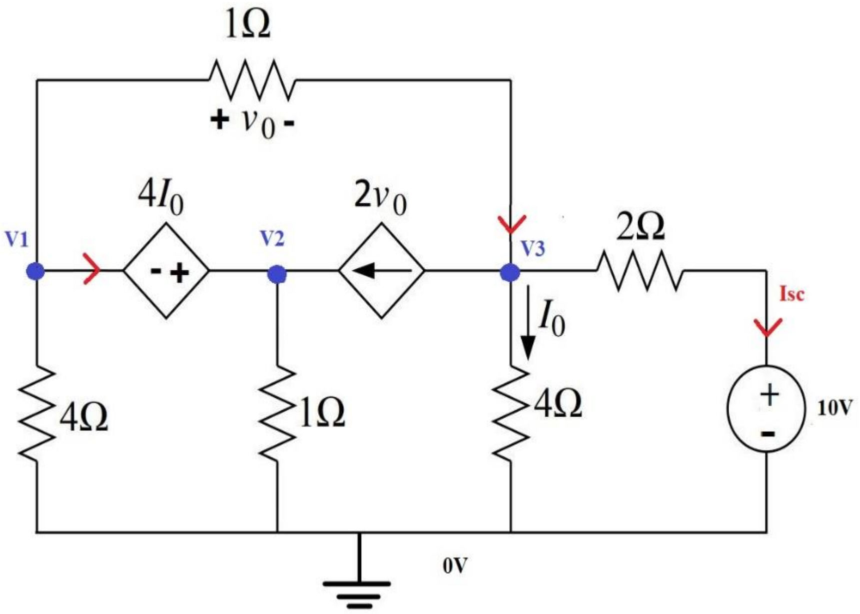

Figure 3.Circuit for Calculating for Isc

In circuit 3 we disconnect the load also disconnect the independent current source and this circuit has a dependent source so we connected 10V voltage source to measure short circuit current I_{SC}.

At the Super node;

$$2V_{\circ} = \frac{V_1}{4} + \frac{V_2}{1} + \frac{V_1 - V_3}{1} \dots\dots\dots\dots\dots\dots\dots..(1)$$

But $V_{\circ} = V_1 - V_3$

Hence the equation 1 becomes;

$$-3V_1 + 4V_2 + 4V_3 = 0 \dots\dots\dots\dots\dots\dots..(2)$$

At node 3;

$$2V_{\circ} + \frac{V_3}{4} = \frac{V_1 - V_3}{1} + \frac{10 - V_3}{2}$$

$$20 = 4V_1 + 0V_2 - V_3 \dots\dots\dots\dots\dots\dots..(3)$$

At the Super node;

$V_2 = V_1 + 4I_\circ$

But $I_\circ = \frac{V_3}{4}$

Hence,$V_2 = V_1 + V_3 \ldots\ldots\ldots\ldots\ldots\ldots..(4)$

Solving equation 2 to 4 we get,

$V_3 = -0.607V$

Now

$I_{SC} = \frac{10+0.607}{2}$

$I_{SC} = 5.303A$

$R_{Th} = \dfrac{V_3}{I_{SC}}$

$= \dfrac{10}{5.303}$

$R_{Th} = 1.89\Omega$

Calculation for V_{Th} :

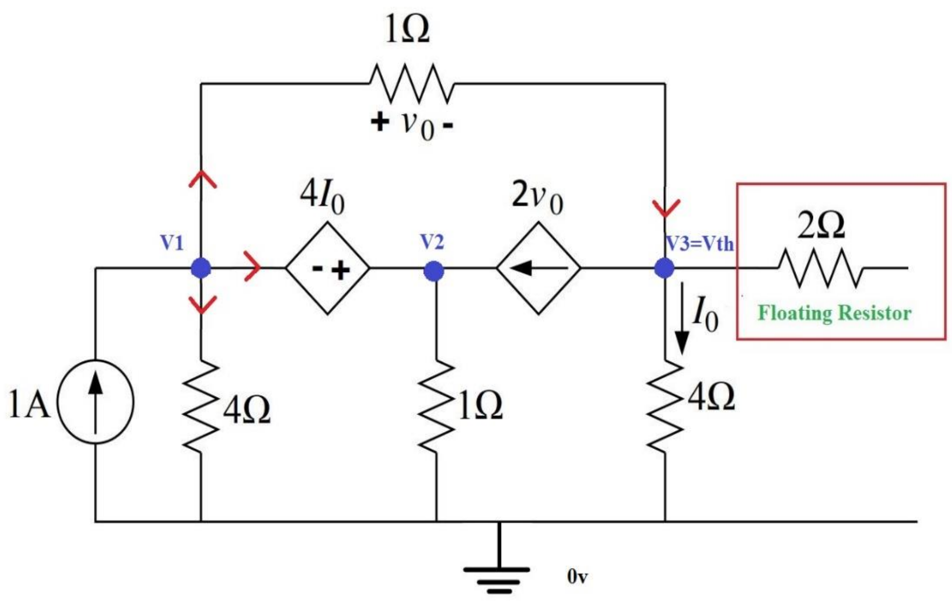

Figure 4.Circuit for Calculating for Vth

At the Super node;

$$1 + 2V_\circ = \frac{V_1}{4} + \frac{V_2}{1} + \frac{V_1 - V_3}{1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(1)$$

But $V_\circ = V_1 - V_3$

Hence the equation 1 becomes;

$$-3V_1 + 4V_2 + 4V_3 = 4 \ldots\ldots\ldots\ldots\ldots\ldots..(2)$$

At node 3;

$$2V_\circ + \frac{V_3}{4} = \frac{V_1 - V_3}{1} \ldots\ldots\ldots\ldots\ldots\ldots..(3)$$

At the Super node;

$V_2 = V_1 + 4I_\circ$

But $I_\circ = \frac{V_3}{4}$

Hence,$V_2 = V_1 + V_3 \ldots\ldots\ldots\ldots\ldots\ldots..(4)$

Solving equation 2 to 4 we get,

$V_{Th} = V_3 = 0.458V$

Calculation for Maximum Power Transfer:

We all know,

DC Circuit $P_{max} = \frac{{V_{Th}}^2}{4R_{Th}}$

$$= \frac{(0.458)^2}{4 \times 1.89}$$

$P_{max} = 27.74$mWatt

Step 3:

3. Using PSpice Simulation with resistance sweep, determine the value of R_L for maximum power transfer and the corresponding maximum power.

Figure 5.PSpice Simulation Graph for Maximum Power Transfer

Step 4:

4. Compare the value of R_L and maximum power obtained in steps 2 and 3

Table 1.Comparing Theoretical Value and PSpice Simulation Software Value

Name	Theoretical Value	PSpice Simulation Value
R_L	1.89Ω	1.887Ω
P_{max}	27.74mWatt	27.706mWatt

So we can say that Theoretical Value and PSpice Simulation Software Value are quietly same.

Conclusion:

Meanwhile using Lab experiments 4, 6, 7 we have done our Lab project. Now we know how to work Thevenin's equivalent circuit and this circuit made our life easy. If we know Voltage and Resistance in a complex circuit then we make a simple series of Thevenin's equivalent circuit and we also calculate maximum power transfer using this circuit. Within a real-life Thevenin's equivalent circuit helps us to make an easy and cheap cost circuit also its saves our time.