Laboratory Application Assignment

In this lab application assignment you will apply Thevenin's theorem to solve for the unknown values of load voltage and load current in a circuit. You will begin by applying Thevenin's theorem to a relatively simple series-parallel circuit and then graduate to a more complex unbalanced bridge circuit.

Equipment: Obtain the following items from your instructor.

- Variable dc voltage source
- Assortment of carbon-film resistors
- DMM

Applying Ohm's Law

Examine the series-parallel circuit in Fig. 10–48. Using Ohm's law, calculate and record the current and voltage for the load resistor, R_L.

I_L = ____________, V_{RL} = ____________

Recalculate I_L and V_{RL} if R_L is changed to 1.8 kΩ. I_L = ____________, V_{RL} = ____________

Recalculate I_L and V_{RL} if R_L is changed to 2.7 kΩ. I_L = ____________, V_{RL} = ____________

As you can see, this can become a very tedious task!

Construct the circuit in Fig. 10–48. Measure and record the load current, I_L, and load voltage, V_{RL}, for each of the different load resistance values.

I_L = ____________, V_{RL} = ____________ (R_L = 1.2 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 1.8 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 2.7 kΩ)

Applying Thevenin's Theorem

Referring to Fig. 10–48, Thevenin's theorem states that the entire network connected to terminals A and B can be replaced with a single voltage source, V_{TH}, in series with a single resistance, R_{TH}. To find the values of V_{TH} and R_{TH}, proceed as follows. Mentally remove the load, R_L, from points A and B, and calculate the open-circuit voltage across these two points. This value is the Thevenin equivalent voltage, V_{TH}. Record this value in Fig. 10–49 as V_{TH} (calculated). Next, with the load, R_L, still removed, mentally short the voltage source, V_T, and calculate the resistance across the open terminals A and B. This value is the Thevenin equivalent resistance, R_{TH}. Record this value in Fig. 10–49 as R_{TH} (calculated).

Next, remove the load, R_L, in Fig. 10–48, and measure the open-circuit voltage across points A and B. Record this value in Fig. 10–49 as V_{TH} (measured). Next, short the voltage source, V_T, by removing the leads from the red and black power supply terminals and clipping them together. With V_T shorted, measure the resistance across terminals A and B. Record this value in Fig. 10–49 as R_{TH} (measured).

Using the calculated values of V_{TH} and R_{TH}, in Fig. 10–49, calculate and record the values of I_L and V_{RL} for each of the following load resistance values.

I_L = ____________, V_{RL} = ____________ (R_L = 1.2 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 1.8 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 2.7 kΩ)

How do these values compare to the calculated values in the original circuit of Fig. 10–48? ______________________________

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Construct the Thevenin equivalent circuit in Fig. 10–49. Adjust both V_{TH} and R_{TH} to the measured values recorded in this figure. Now measure and record the values of I_L and V_{RL} for each of the following load resistance values.

I_L = ____________, V_{RL} = ____________ (R_L = 1.2 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 1.8 kΩ)
I_L = ____________, V_{RL} = ____________ (R_L = 2.7 kΩ)

How do these values compare to the measured values in the original circuit of Fig. 10–48? ______________________________

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Figure 10–48

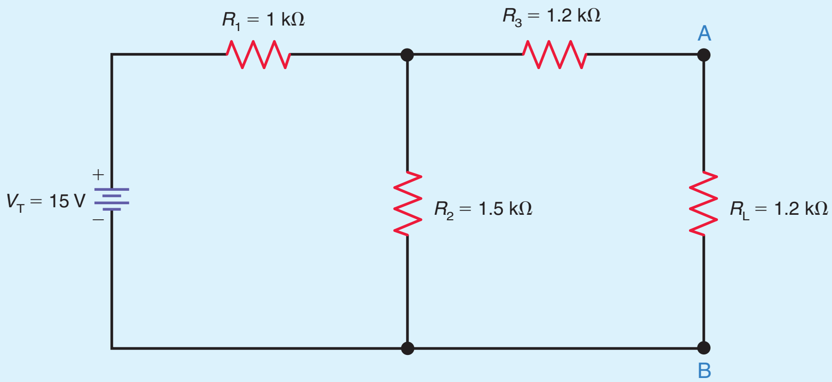
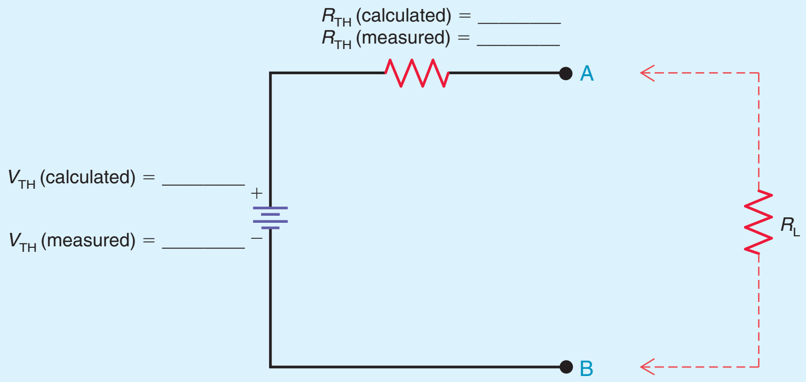


Figure 10–49



The magic in Thevenin's theorem lies in the fact that the Thevenin equivalent circuit driving terminals A and B remains the same regardless of the value of R_L. In the original circuit of Fig. 10–48, every time R_L was changed the entire circuit would have to be resolved. Not with Thevenin's theorem! Just plug the new value of R_L into the Thevenin equivalent circuit, and make one simple calculation.

Unbalanced Bridge Circuit

Refer to the unbalanced bridge circuit in Fig. 10–50. By applying Thevenin's theorem, determine the value of R_L that will provide a load current, I_L, of 1.2 mA. Show all your calculations as well as your Thevenin equivalent circuit.

Construct the original circuit in Fig. 10–50. For R_L, insert the value determined from your calculations. Finally, measure and record the value of I_L. I_L = ___________

Figure 10–50