EE 360 Circuits & Electronics Lab. #2

Superposition Theorem

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ABSTRACT

By using the superposition theorem, the voltage drop across a certain resister was figured out paper example and experimentally. Knowing the mathematical calculated voltage drops in three different cases, the experiment was set up building the circuits using the three different resisters, and the voltages drops values were compared with the pre-lab values. The pre-lab section gave the voltage drop was 9.82V which matched the experimental results fairly well of 9.89V.

OBJECTIVE

The purpose of the laboratory was to confirm that the voltage drop could be calculate by using the method of superposition theorem and to become familiar with the use of the superposition theorem, and to construct a electric circuit in order to examine the voltage drop across certain resister. Conclusively, the results from the pre-lab calculations and the experimental results were compared.

PROCEDURE

The first step of this lab was the pre-lab section had to be done. The objective of the pre-lab was to calculate the voltages drop across the 5.6KΩ resistor, which is shown in Fig 1.

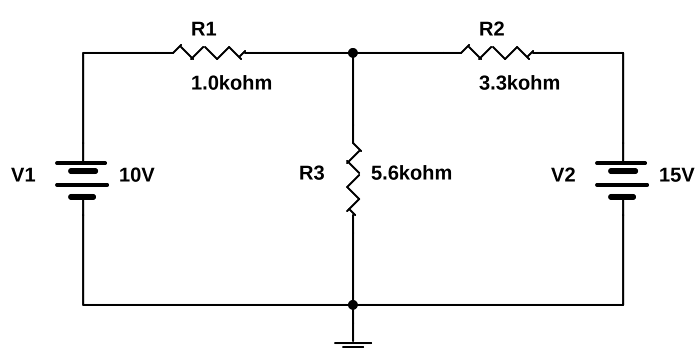

Fig 1. Experimental circuit.

The pre-lab calculations above were done by the superposition theorem. In order to proceed the calculation, the experimental circuit was assumed without 15V because when 15V was took off, the resistor between R2 and R3 were parallel. Fig 2 indicates the way it was.

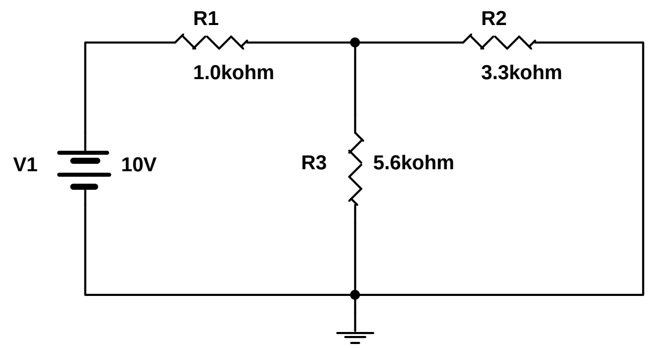

Fig 2. Experimental circuit without 15V.

Then, summation of R2 and R3 could be calculated following way.

$$R_a = \frac{R2 \times R3}{R2 + R3} = \frac{5.6K \times 3.3K}{5.6K + 3.3K} = 2.076K\Omega$$

And, the voltage drop through the summation of R2 and R3 could be calculated.

$$V_a = V1 \times \frac{R_a}{R1 + R_a} = 10 \times \frac{2.076K}{1K + 2.076K} = 6.75V$$

Next, the experimental circuit was assumed without 10V (Fig 3). When 10V is not in the circuit, it can be said that the resister between R1 and R3 are parallel. Therefore, following calculation could be composed.

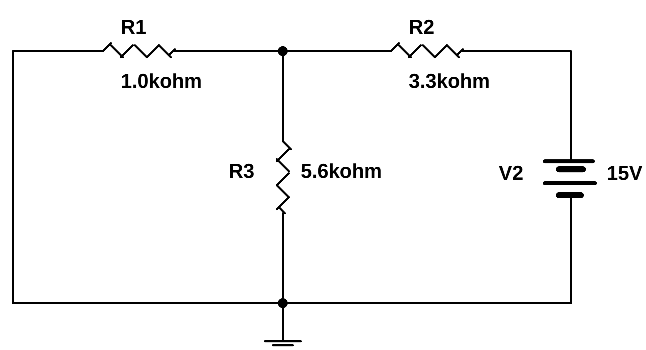

Fig 3. Experimental circuit without 10V.

Then, summation of R1 and R3 could be calculated following way.

$$R_b = \frac{R1 \times R3}{R1 + R3} = \frac{1K \times 5.6K}{1K + 5.6K} = 0.848K\Omega$$

And, the voltage drop through the summation of R2 and R3 could be calculated.

$$V_b = V2 \times \frac{R_b}{R1 + R_b} = 15 \times \frac{0.848K}{3.3K + 0.848K} = 3.07V$$

Following the superposition theorem, the voltage drop across 5.6KΩ in Fig 1 would be summation of Va and Vb, which were calculated above. Therefore, following calculation was derived.

$$V_{5.6K} = V_a + V_b = 6.75 + 3.07 = 9.82V$$

9.82V was the calculated value of the voltage drop across 5.6KΩ.

Knowing those calculated values, the real experiment was performed. The experimental circuit was constructed on the protoboard by using 1K, 3.3K, and 5.6K resisters. The experiment was consists of four parts. Part 1 was to measure the voltage drop across resister of 5.6K. Part 2 was, without 10V, to measure the voltage drop across 5.6K by source of 15V, and part 3 was vice versa of part 2 – without 15V, using 10V source. Finally, part was to add the results of part 2 and 3 together.

RESULTS

	Pre-lab values	Experimental values	Error %
Part 1. with 10V and 15V	**(9.82V)**	**9.89V**	**0.71%**
Part 2. without 15V, with 10V	**6.75V**	**6.83V**	**1.19%**
Part 3. without 10V, with 15V	**3.07V**	**3.08V**	**0.33%**
Part 4. sum of part 2 & 3	**9.82V**	**9.91V**	**0.92%**

DISCUSSION

In examining the results and comparing the values, the experimental results met the expected values to a reasonable amount. The voltages drop across the resister of 5.6K in the pre-lab section was 9.82V where the experimental measurement was 9.89V. The error percent between pre-lab value and experimental value was 0.71%, and this low percentage error showed the success of this experiment. Moreover, in the pre-lab, the voltage drop across 5.6K without 15V was 6.75 where the experimental value was 9.89V, and the error percent was 1.19%. The voltage drop across the 5.6K without 10V was 3.07V where the experimental value was 3.08V, and the error percent was 0.33V. The total of part 2 and 3 in the pre-lab was 9.82V where experimental was 9.91, and error percent was 0.92%. These very low error percent indicated that the superposition theorem is very powerful tool to present circuit planning to the real circuit.

CONCLUSION

Overall, in observing the results and the error calculated in the discussion section, the laboratory was a success where the experimental values met the theoretical values calculated from the pre-lab section. The laboratory showed how the superposition theorem comes in act with the circuit and how it affects the voltages drop in a circuit.