Al-Mustaqbal University / College of Engineering & Technology

Department of Communications technology Engineering)

Class(First)

Subject (DC Electrical Circuits Lab UOMU020701)

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1st term – (series and parallel connection)

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Experiment No.3

Series and Parallel Connection

1. Introduction

1.1 Objective:

To study the properties of series and parallel connection.

1.2 Components

1. DC circuit training system
2. Set of wires.
3. DC Power supply
4. Digital A.V.O. meter

1.3 Theory

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1.3.1. The Series Circuit

A series circuit or "series-connected circuit" is a circuit having just one current path. Thus, Figure 1 is an example of a "series circuit" in which a battery of constant potential difference V volts, and three resistances, are all connected "in series

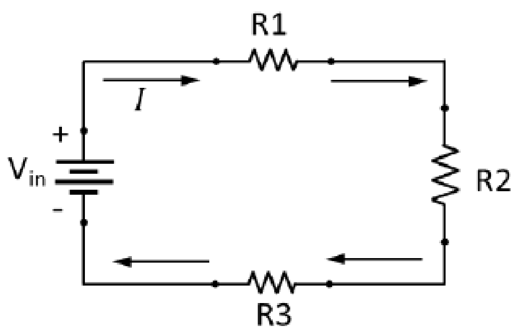

Figure 1

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Since a series circuit has just one current path, it follows that all the components in a series circuit carry the same current I, a fact evident from inspection of Figure 1. The current I is assumed to be a flow of positive charge, and thus flows out of the positive terminal of the battery and around through the external circuit, re-entering the battery at the negative terminal. This is indicated by the arrows in Figure 1. In a series circuit, the total resistance, R_T, that the battery sees is equal to the SUM of the individual resistances. Thus, in the particular case of Figure 1 the battery sees a total resistance, $R_T = R_1 + R_2 + R_3$, while in the general case of "n" resistances connected in series the battery sees a total resistance of: $R_T = R_1 + R_2 + R_3 + \ldots.. R_n$

By Ohm's law, it follows that the current I in a series circuit is equal to;

$$I = \frac{V_T}{R_T} = \frac{V_T}{R1 + R2 + R3 + \cdots \ldots Rn}$$

On the other hand, consumes electrical energy, removing it from the circuit in the form of heat. Since resistance does not produce or generate electrical energy, it is a non-active or passive type of circuit element. The potential difference between the terminals of a resistor is called the voltage drop across the resistor, and, is equal to the current I times the resistance R; that is, the "voltage drop" across a resistance of R ohms carrying a current of I amperes is I×R volts

$$V = IR_T$$

$$V = I(R_1 + R_2 + \ldots\ldots. + R_n)$$

$$V = IR_1 + IR_2 + \ldots\ldots\ldots + IR_n$$

We have the important fact that:

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In a series circuit, the applied voltage is equal to the sum of the voltage drops.

It should be pointed out that the voltage drop across a resistor is always from plus to minus in the direction of the current flow, a fact illustrated in Figure 2.

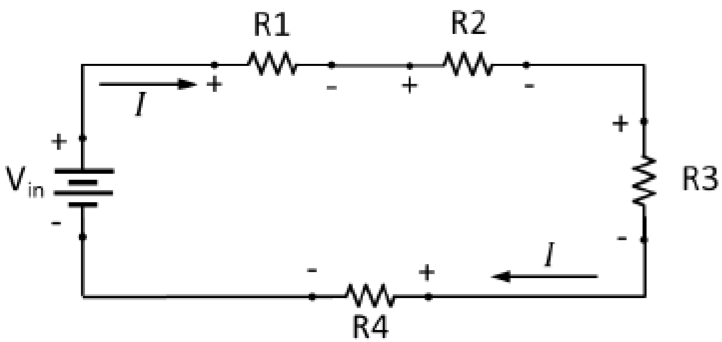

Figure 2

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1.3.2. The Parallel Circuit

A parallel circuit is one in which the battery current divides into a number of "parallel paths." This is shown in Figure 3, in which a battery, of constant V volts, delivers a current of I amperes to a load consisting of any number of n resistances connected "in parallel."

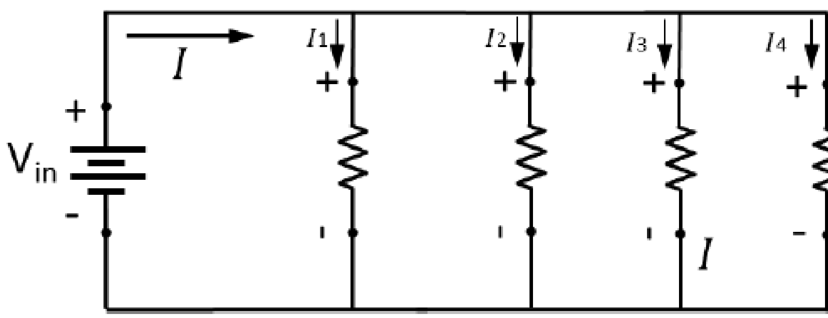

Figure 3

The currents in the individual resistances are called the "branch currents," and the battery current I is often called the "line current." From inspection of Figure 3 we see that, in a parallel circuit, the battery current I is equal to the sum of the branch currents

$$I_T = I_1 + I_2 + I_3 + \cdots ... I_n$$

if the battery voltage V is applied equally to all n resistances; that is, the same voltage V is applied to all the parallel branches. Hence, by Ohm's law, the individual branch currents in Figure 3 have the values:

$$I_1 = V/R1 \quad , I_2 = V/R2 \quad , I_n = V/Rn$$

Then, we have:

$$I = V\left(\frac{1}{R1} + \frac{1}{R2} + \cdots + \frac{1}{Rn}\right)$$

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Now let RT be the total resistance as seen by the battery in Fig.(3). Then, by Ohm's law, it has to be true that:

$$I=\frac{V}{R_T}$$

Since the left-hand sides of the last two equations are equal, the two righthand sides are also equal. Setting the two right-hand sides equal, then canceling the Vs, gives

2. Experiment procedure:

1. Using the DC circuit trainer, connect the circuit Shown in Figure 4, take VT =10V, and R_1= 1kΩ, R_2 = 470Ω, and R_3 =5kΩ.

2. Measured the voltage and current of "R_1, R_2, and R_3", then record it in table below

	1kΩ	470kΩ	5kΩ	
V (Volt)				V_T(Volt)=
I(mA)				I_T(mA)=

3. By using ohm's law, Calculate the R_T

4. Disconnect the DC power supply, and then measured the equivalent resistance by using the AVO meter only.

R1=1kΩ

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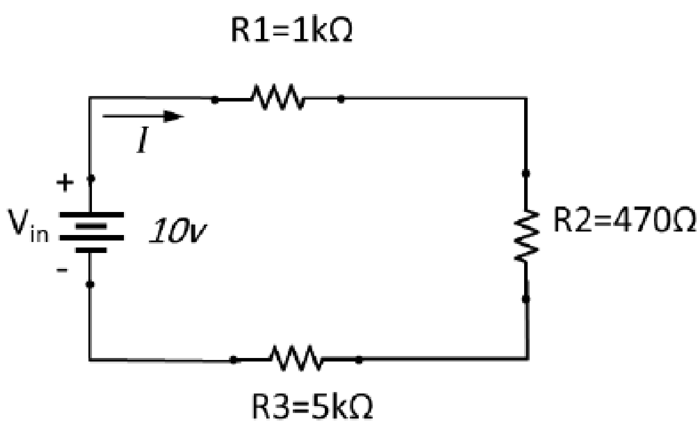

Figure 4

5. Using the DC circuit trainer, connect the circuit Shown in Figure 5, and take V_T =10V, and R_1=1KΩ, R_2 = 470Ω and R_3 =5KΩ.

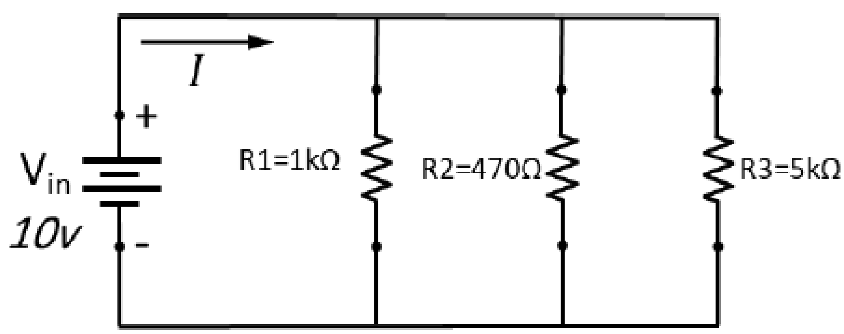

Figure 5

6. Measured the voltage and current of "R_1, R_2, and R_3", then record it in table below

	1kΩ	470kΩ	5kΩ	
V (Volt)				V_T(Volt)=
I(mA)				I_T(mA)=

7. Disconnect the DC power supply, and then measured the equivalent resistance by using the AVO meter only

3. Discussion:

1. Three resistors (R_1, R_2 and R_3) are connect in parallel, prove that

$$R_T = \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

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2. For the circuit shown in Figure 6, find R_T, V_2.

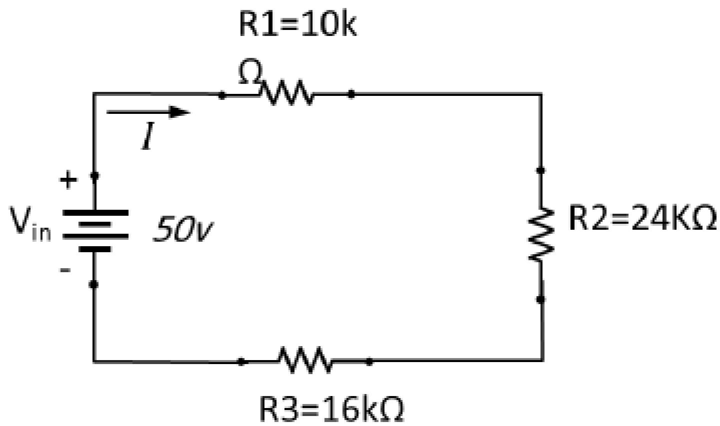

Figure 6

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