Chapter 6 Series Circuits Notes

In previous units we have learned the four basic parts to make a complete circuit

- The energy source
- The control device
- The conductor
- The load

We have also learned that loads can be connected in

- SERIES
- PARALLEL
- SERIES-PARALLEL COMBINATION

In this unit we will discuss topics like

- Principles of a Series Circuit

—***Voltage, Current, Resistance*** and ***Power*** in a series circuit.

- Troubleshooting a series circuit using a voltmeter

A ***series*** circuit provides only one path for the electrons to flow

- The electrons flow from the negative side of the energy source through the load to the positive side of the energy source

An ***open*** circuit means the circuit is not complete

- The switch may be in the off position
- A wire could be broke
- The load could be broke
- Could have a loose connection.

Devices like *switches*, *fuses* and *circuit breakers* are connected in series with the load.

Polarity

- It is necessary to know the ***polarity*** in DC circuits to properly connect some components and instruments (like ***DC meters***) into the circuit.
- In DC circuit the electrons flow from a negative point to a positive point.

VOLTAGE IN A SERIES CIRCUIT

- The total voltage applied to a series circuit is *automatically spread across the loads* or devices in the circuit.
- The voltage across any load will be that amount needed to force the electrons through the resistance of that load.
- This is called a ***VOLTAGE DROP***

Voltage

- Total voltage is equal to the sum of the individual voltage drops….
- Et = E1 + E2 + E3….

Ohm's Law states, the *voltage drop* across any load in the circuit is equal to the product of the current through the load and the resistance of that load.

- E = I x R
- E= (Voltage drop across the load)
- I= (Current through the load)
- R= (Resistance of the load)

KIRCHHOFF'S LAW OF VOLTAGE

- In a series circuit, the sum of the voltage drops across the loads is equal to the total voltage applied to the circuit.

CURRENT IN A SERIES CIRCUIT

- Kirchhoff’s law states that all the ***current*** that flows into a point leaves that point.
- ***Current remains the same through out a series circuit.***

Current

- Total current is equal to the current flowing through any of the loads.
- It = total current flowing in the circuit.
- It = I1 = I2 = I3….

RESISTANCE IN A SERIES CIRCUIT

- The *total resistance* (of the entire circuit) is the sum of all the resistances in the series circuit.

Total Resistance can be calculated with this formula.

- Rt = R1 + R2 + R3….

Determining an Unknown Voltage

- To find the total voltage use the formula
- ***Et = It x Rt***

- ***To find the voltage of just one load (R1) use the formula***
- **E1= I1 x R1**

To find the voltage of resistor 2 (R2) use the formula
E2 = I2 x R2

Determining an Unknown Current

- To find the total current use the formula
- It = Et / Rt

- ***To find the current of just one load (R1) use the formula***
- **I1= E1 / R1**

To find the current of resistor 2 (R2) use the formula
I2 = E2 / R2

Determining an Unknown Resistance

- To find the total resistance use the formula
- Rt = Et / It

- ***To find the resistance of just one load (R1) use the formula***
- **R1 = E1 / I1**

To find the resistance of resistor 2 (R2) use the formula
R2 = E2 / R2

Troubleshooting a Series Circuit

- One of the most common circuit faults in a series circuit is an open. (open-circuit)

- A voltmeter, combined with the knowledge of the laws of voltages, is a quick and easy method of analysis.

Troubleshooting a Series Circuit with a Voltmeter

- To begin the troubleshooting process, measure to determine if there is voltage at the supply. (If the voltage is good move to the fuse.)

- Take a voltage drop reading across the fuse. *A good fuse will <u>not</u> produce a voltage drop.*

- *A blown fuse <u>will</u> produce a voltage drop* that is equal to the source voltage.