

Basic Electric Circuits

Series Circuits

Lesson 7
EET 150



Series Circuit Learning Objectives

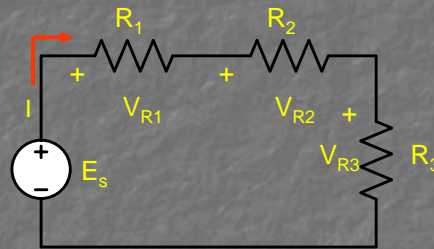
- ▣ **In this lesson you will:**
- ▣ learn the characteristics of a series electric circuit.
- ▣ solve a series electric circuit using a voltmeter and Ohm's Law
- ▣ see how a series circuit can be used as a voltage divider
- ▣ solve example problems
- ▣ find the equivalent resistance for a series-connected string of resistors



Series Circuits

Series Circuit Characteristics

- Components connected end-to-end
- Current only follows one path
- Voltage of source divides between components according to their value
- Sum of component voltage values must equal source value

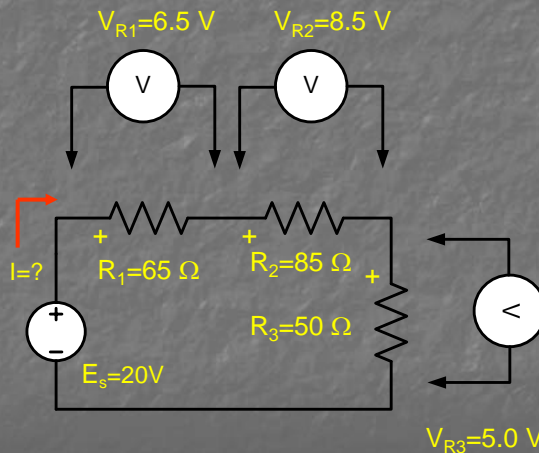


$$E_s = V_{R1} + V_{R2} + V_{R3} \quad \text{Kirchhoff's Voltage Law}$$



Series Circuits

Solving series circuits using Ohm's law and a voltmeter



$$I = \frac{V_{R1}}{R_1} = \frac{6.5\text{ V}}{65\ \Omega} = 0.1\text{ A}$$

$$I = \frac{V_{R2}}{R_2} = \frac{8.5\text{ V}}{85\ \Omega} = 0.1\text{ A}$$

$$I = \frac{V_{R3}}{R_3} = \frac{5.0\text{ V}}{50\ \Omega} = 0.1\text{ A}$$

Current, I same in all resistors

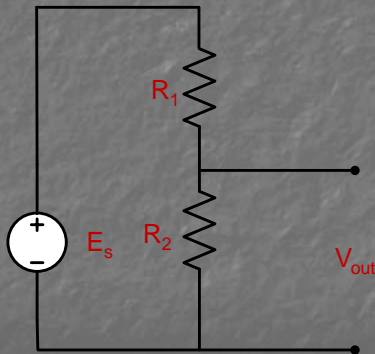
$$E_s = V_{R1} + V_{R2} + V_{R3} = 6.5 + 8.5 + 5 = 20\text{V}$$



Series Circuits

The Voltage Divider Circuit

The voltage divider circuit is a series circuit with two resistors



Design Formula

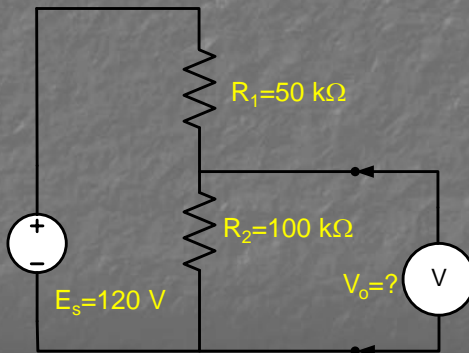
$$V_{out} = \left(\frac{R_2}{R_1 + R_2} \right) E_s$$

Voltage across resistor, R_2 , is considered the output of the circuit.



Series Circuits

Example: A 120 V dc source is series connected to a 50 k Ω and a 100 k Ω resistor. (See the figure.) What is the voltage output read by the meter?



$$V_{out} = \left(\frac{R_2}{R_1 + R_2} \right) E_s$$

$$V_o = \left(\frac{100 \text{ k}\Omega}{50 \text{ k}\Omega + 100 \text{ k}\Omega} \right) 120 \text{ V}$$

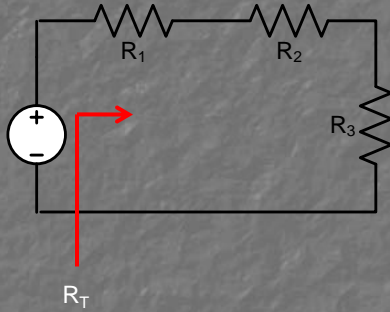
$$V_o = \left(\frac{100 \text{ k}\Omega}{150 \text{ k}\Omega} \right) 120 \text{ V}$$

$$V_o = \left(\frac{2}{3} \right) 120 \text{ V} = 80 \text{ V}$$



Series Resistors

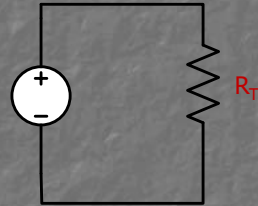
Simplifying series resistors



$$R_T = R_1 + R_2 + R_3$$

R_T is the equivalent value of the series resistors

Equivalent Circuit



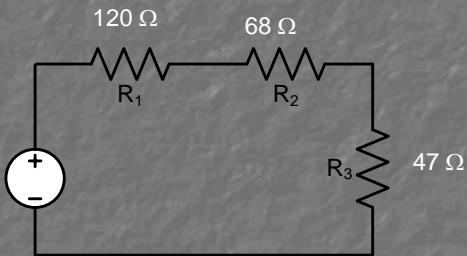
Voltage source will supply the same current, I , to R_T as to $R_1 + R_2 + R_3$.

This formula works for any number of resistors



Simplifying Series Resistors Example

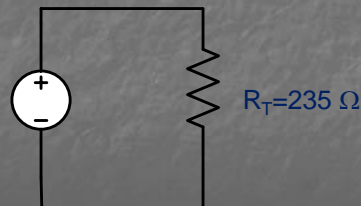
Find the equivalent resistance, R_T , for the circuit below.



$$R_T = R_1 + R_2 + R_3$$

$$R_T = 120 \Omega + 68 \Omega + 47 \Omega$$

$$R_T = 235 \Omega$$



End Lesson 7 EET 150

Coming Next: Parallel Electric Circuits

BASIC ELECTRIC CIRCUITS
SERIES CIRCUITS

