

Chapter 3

Basic Electrical Circuits

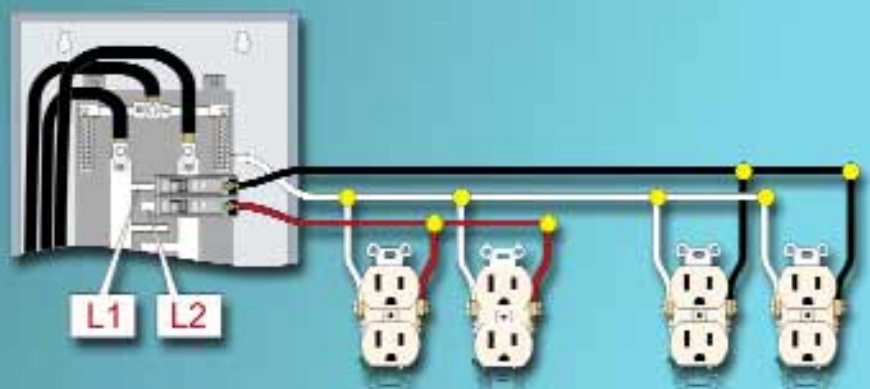
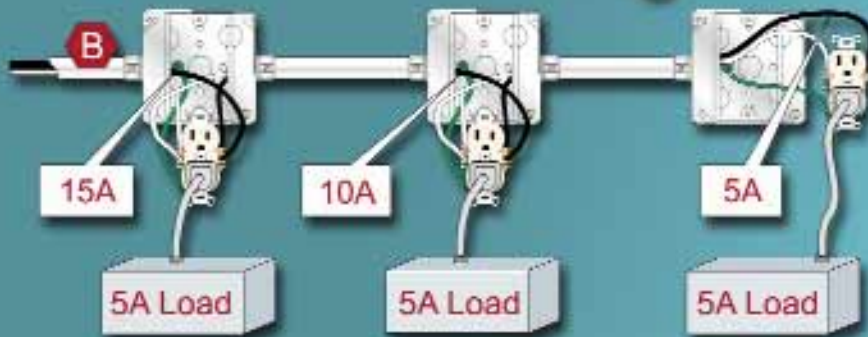
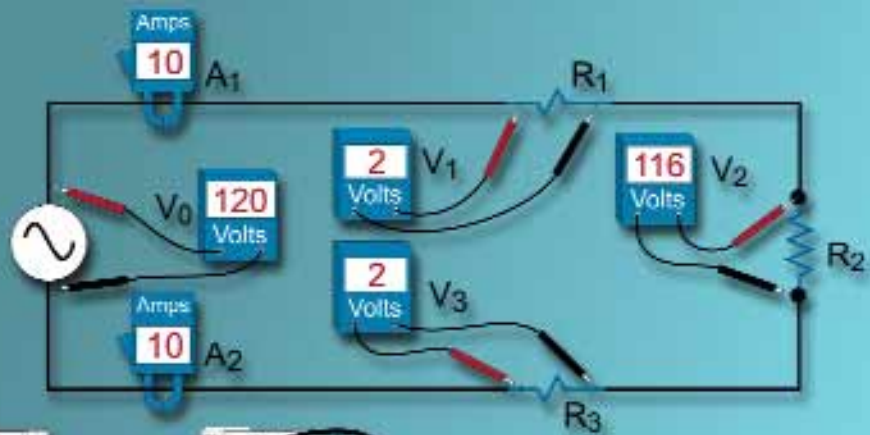


Unit 10 – Series Circuits

Unit 11 – Parallel Circuits

Unit 12 – Series-Parallel Circuits

Unit 13 – Multiwire Circuits





Unit 10 – Series Circuits

Introduction

A series circuit is a circuit in which a specific amount of current leaves the voltage source and flows through every electrical device in a single path before it returns to the voltage source.

Figure 10-1

It is important to understand that in a series circuit, current is identical through ALL circuit elements of the circuit.



Figure 10-1

10.1 Practical Uses of the Series Circuit

In a series circuit, if any part of the circuit is open, the current in the circuit will stop.

Lighting

A series circuit is not useful for lighting because if one lamp burns out, all the other lamps on the circuit will go out. Figure 10-2

Many strings of Christmas lights are made in series circuits – if one bulb burns out, it requires examining EVERY bulb in order to find the bad one because the entire string stops burning when this occurs! Most of the newer Christmas light lamps used in series string lighting have a shorting bar. When one lamp burns out, the lamp

leads are shorted together (shorting bar) and the rest of the string stays lit.

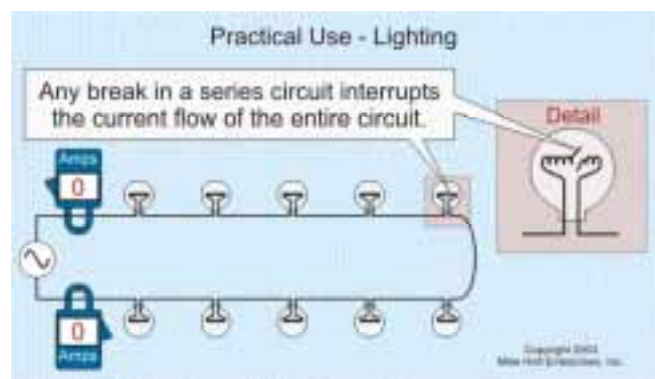


Figure 10-2



Unit 10 – Summary

Introduction

A series circuit is a circuit in which a specific amount of current leaves the voltage source and flows through every electrical device in a single path before it returns to the voltage source. Current is identical through ALL circuit elements of the circuit.

10.1 Practical Uses of the Series Circuit

In a series circuit, if any part of the circuit is open, the current in the circuit will stop. For most practical purposes, series circuits (closed-loop systems) are not used for building wiring; however, they are often used for control and signal circuits.

The internal wiring of many types of equipment, such as motor windings, will be connected in series.

10.2 Understanding Series Calculations

Resistance

In a series circuit, the total circuit resistance is equal to the sum of all the series resistances. Resistance is additive: $R_T = R_1 + R_2 + R_3 + R_4$.

Kirchoff's Voltage Law

Kirchoff's voltage law states that in a series circuit, the sum of the voltages (or "voltage drops") across all of the resistors in the series circuit is equal to the applied voltage.

Kirchoff's Current Law

Kirchoff's current law states that the sum of currents flowing into a junction equals the sum of currents flowing away from the junction. Another way to say it is, current flowing through each resistor of the series circuit will be the same.

Power

The power consumed in a series circuit will equal the sum of the power consumed by all of the resistances in the series circuit.

10.3 Series Circuit Calculations

When performing series circuit calculations, the following steps should be helpful:

Step 1 Determine the resistance of each resistive element in the circuit.

Step 2 Calculate the total resistance (R_T) of the circuit, $R_T = R_1 + R_2 + R_3 + R_4$

Step 3 The current of the circuit can be determined by the formula: $I = E_S/R_T$

E_S = Voltage Source

R_T = Total circuit resistance

10.4 Power Calculations

If you know the current of the circuit and the resistance of each resistor, the power of each resistor can be determined by the formula: $P = I^2R$.

10.5 Variations

There are often many different ways to solve an electrical circuit problem involving voltage, current, resistance and power.

10.6 Series Circuit Notes

Note 1: The total resistance of a series circuit is equal to the sum of all the resistances of the circuit.

Note 2: Current is the same value through all the resistances.

Note 3: The sum of the voltage drops across all resistances equals the voltage of the source.

Note 4: The sum of the power consumed by all resistors equals the total power consumed by the circuit.



Unit 10 – Practice Questions

Introduction

1. A series circuit is a circuit in which a specific amount of current leaves the voltage source and flows through every electrical device in a single path before it returns to the voltage source.
(a) True (b) False

10.1 Practical Uses of the Series Circuit

2. For most practical purposes, series circuits are used for _____ circuits.
(a) signal (b) control (c) a and b (d) none of these
3. A 115/230V rated motor connected to a 230V circuit must have the windings connected in series so that each winding will receive at least 230V.
(a) True (b) False

10.2 Understanding Series Calculations

4. Resistance opposes the flow of electrons. In a series circuit, the total circuit resistance is equal to the sum of all the resistances in series.
(a) True (b) False
5. The opposition to current flow results in a _____ of the circuit voltage.
(a) current (b) voltage (c) voltage drop (d) none of these
6. Kirchoff's voltage law states that in a series circuit, the sum of the voltage drops across all of the resistors will equal the applied voltage.
(a) True (b) False
7. No matter how many resistances there are in a series circuit, the sum of the voltages across all of the resistances will equal the voltage of the source according to the Law of Proportion.
(a) True (b) False
8. Kirchoff's current law states that in a series circuit, the current is _____ through the transformer, the conductors, and the appliance.
(a) proportional (b) distributed (c) additive (d) the same
9. The power consumed in a series circuit is equal to the power consumed by the largest resistance in the series circuit.
(a) True (b) False