

Technician License Course

Chapter 3

Lesson Plan Module 4 – Electricity



ARRL *The national association for
AMATEUR RADIO*

Fundamentals of Electricity

- Radios are powered by electricity and radio signals are a form of electrical energy.
- A basic understanding of how we control electricity allows you to better install and operate your radio.

Fundamentals of Electricity

- Electrical charge can be positive or negative.
 - Opposite charges attract each other
- Electrical current is the flow of *electrons*.
 - Electrons are negatively-charged atomic particles, usually surrounding an atom's positively-charged nucleus of protons (positive) and neutrons (neutral – no charge)
 - Electrons move in response to an *electromotive force* and can move independently of atoms



ARRL The national association for
AMATEUR RADIO

Basic Electrical Concepts

- Current: the movement of electrons, measured in *amperes* (A) by an *ammeter*, and represented by I in formulas
- Voltage: the amount of electromotive force (emf), also called *electrical potential*, measured in *volts* (V) by a *voltmeter*, represented by E or V in formulas

Basic Electrical Concepts

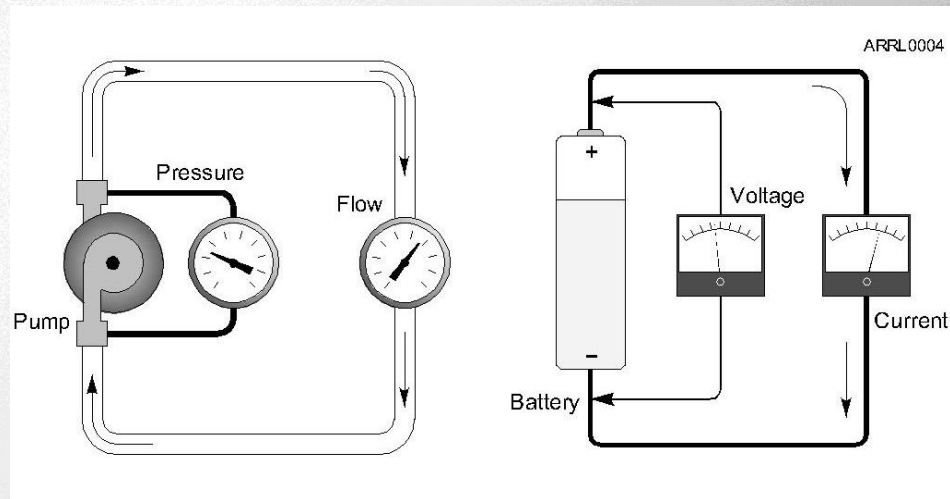
- Resistance: the opposition to the movement of electrons, measured in *ohms* (Ω) by an *ohmmeter* and represented by R in formulas.
- Resistance is like friction and turns electrical energy into heat when current flows.
- *Conductors* permit current flow (low resistance) and *insulators* block current flow (high resistance).



ARRL The national association for
AMATEUR RADIO

Basic Electrical Concepts

- The flow of water through a pipe is a good analogy to understand the three characteristics of electricity and how they are related.



ARRL The national association for
AMATEUR RADIO

Basic Electrical Concepts

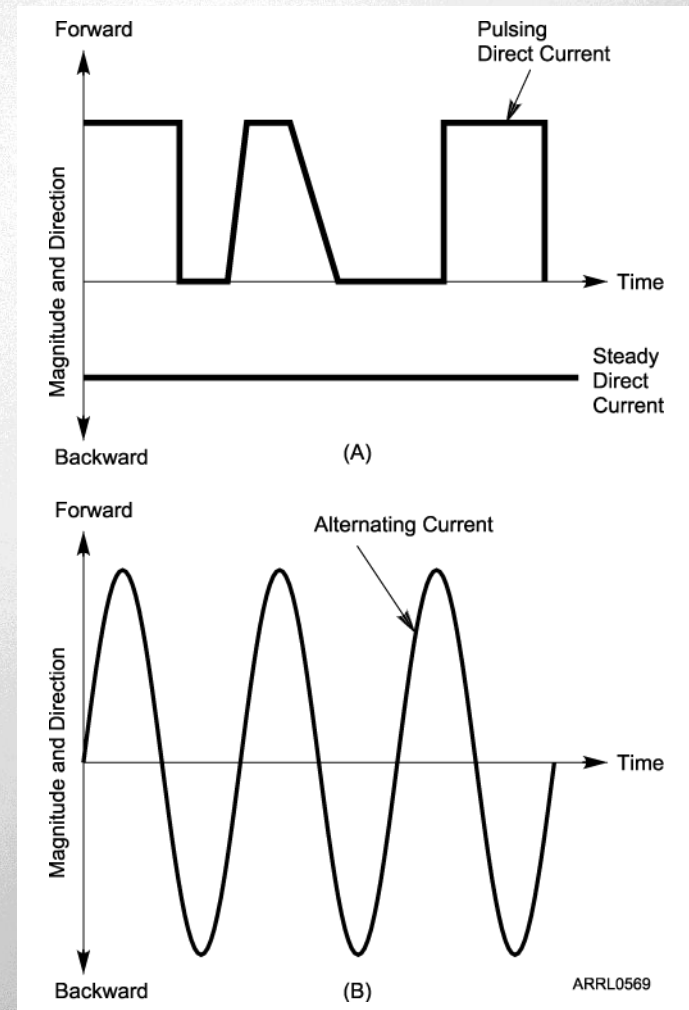
- Voltage from a *source* of electrical energy causes current to flow.
- Resistance is a material's opposition to the flow of current.
- Voltage, current and resistance affect each other. For example, higher voltage (bigger push) causes more current (more flow).



ARRL The national association for
AMATEUR RADIO

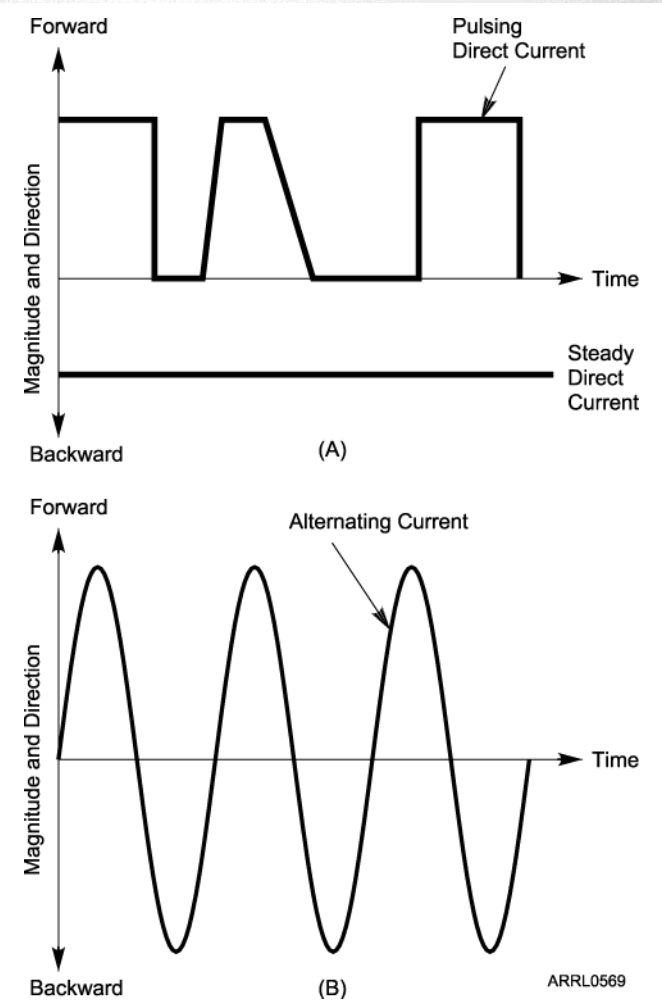
The Two Kinds of Current

- Current that flows in only one direction, is called direct current (dc).
 - Batteries are a common source of dc.
- Current that flows in one direction then in the opposite direction is called alternating current (ac).
 - Household current is ac



The Two Kinds of Current

- AC current reverses direction on a regular basis
 - Each process of reversing is a *cycle*.
 - The number of cycles per second is *frequency*, measured in hertz (Hz).
- 1 Hz = 1 cycle per second

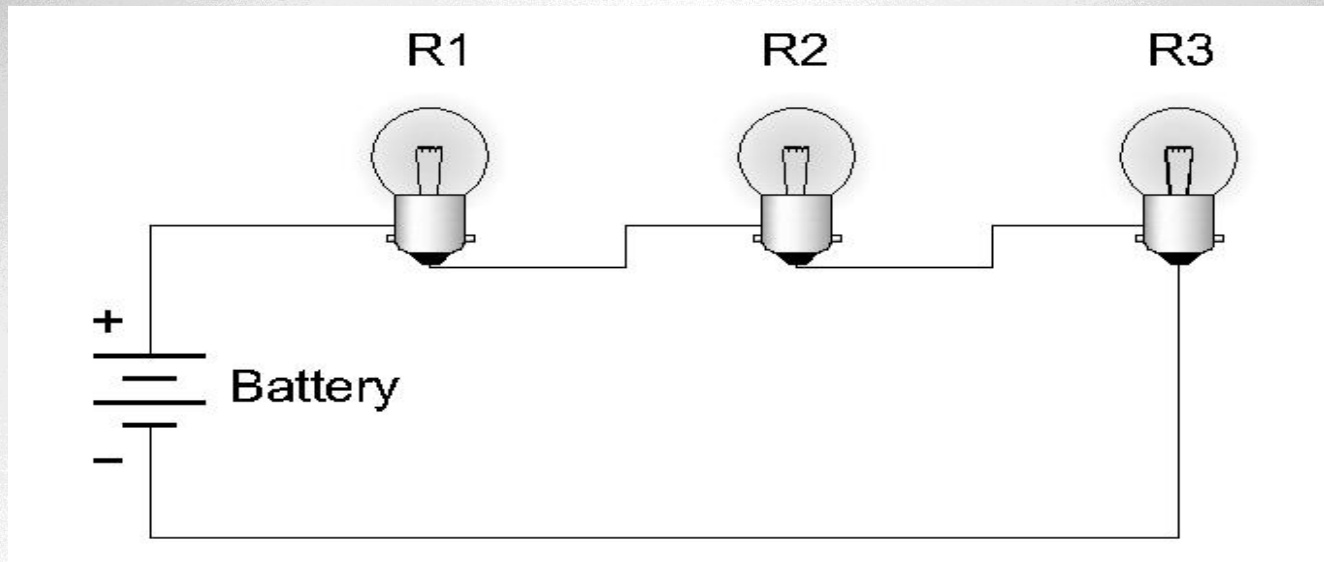


The Electric Circuit: An Electronic Roadmap

- For current to flow, there must be a path from one side of the energy source to the other side of the source – this path is called a *circuit*.
 - There must be a pipe (conductive path) through which the water (current) can flow.
- There are two types of electric circuits.
 - Series and parallel

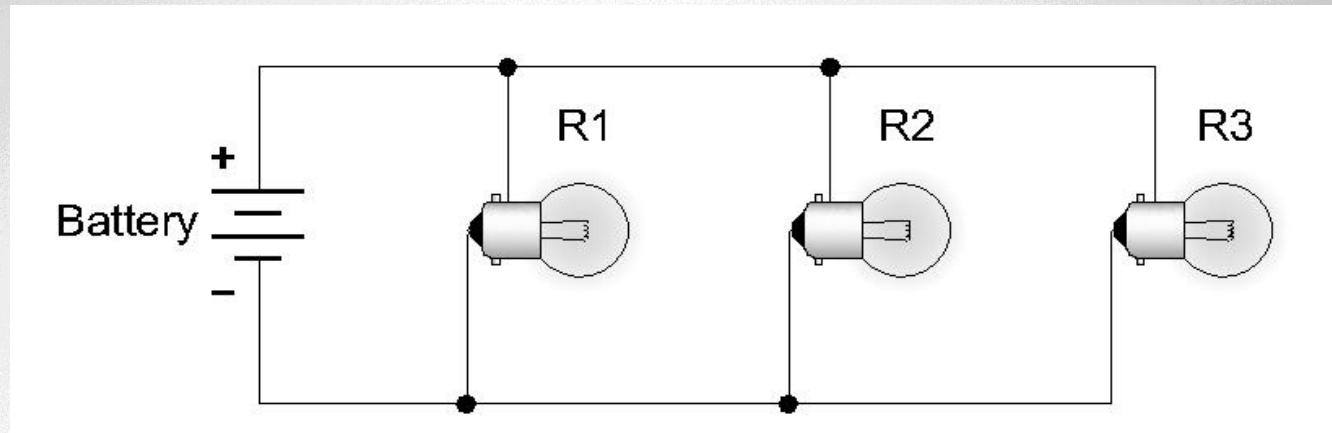
Series Circuits

- Series circuits provide one and only one path for current flow.



Parallel Circuits

- Parallel circuits provide multiple paths for current flow.



ARRL The national association for
AMATEUR RADIO

Practice Questions



Electrical current is measured in which of the following units?

- A. Volts
- B. Watts
- C. Ohms
- D. Amperes

T5A01 HRLM (3-1)



Electrical current is measured in which of the following units?

- A. Volts
- B. Watts
- C. Ohms
- D. Amperes**

T5A01 HRLM (3-1)



What is the name for the flow of electrons in an electric circuit?

- A. Voltage
- B. Resistance
- C. Capacitance
- D. Current

T5A03 HRLM (3-1)



What is the name for the flow of electrons in an electric circuit?

- A. Voltage
- B. Resistance
- C. Capacitance
- D. Current**

T5A03 HRLM (3-1)



What is the name for a current that flows only in one direction?

- A. Alternating current
- B. Direct current
- C. Normal current
- D. Smooth current

T5A04 HRLM (3-6)



What is the name for a current that flows only in one direction?

- A. Alternating current
- B. Direct current**
- C. Normal current
- D. Smooth current

T5A04 HRLM (3-6)



What is the electrical term for the electromotive force (EMF) that causes electron flow?

- A. Voltage
- B. Ampere-hours
- C. Capacitance
- D. Inductance

T5A05 HRLM (3-1)



What is the electrical term for the electromotive force (EMF) that causes electron flow?

- A. Voltage
- B. Ampere-hours
- C. Capacitance
- D. Inductance

T5A05 HRLM (3-1)



Which of the following is a good electrical conductor?

- A. Glass
- B. Wood
- C. Copper
- D. Rubber

T5A07 HRLM (3-4)



Which of the following is a good electrical conductor?

- A. Glass
- B. Wood
- C. Copper**
- D. Rubber

T5A07 HRLM (3-4)



Which of the following is a good electrical insulator?

- A. Copper
- B. Glass
- C. Aluminum
- D. Mercury

T5A08 HRLM (3-4)



Which of the following is a good electrical insulator?

- A. Copper
- B. Glass**
- C. Aluminum
- D. Mercury

T5A08 HRLM (3-4)



What is the name for a current that reverses direction on a regular basis?

- A. Alternating current
- B. Direct current
- C. Circular current
- D. Vertical current

T5A09 HRLM (3-6)



What is the name for a current that reverses direction on a regular basis?

- A. Alternating current
- B. Direct current
- C. Circular current
- D. Vertical current

T5A09 HRLM (3-6)



What is the basic unit of electromotive force?

- A. The volt
- B. The watt
- C. The ampere
- D. The ohm

T5A11 HRLM (3-1)

What is the basic unit of electromotive force?

- A. The volt
- B. The watt
- C. The ampere
- D. The ohm

T5A11 HRLM (3-1)

What term describes the number of times per second that an alternating current reverses direction?

- A. Pulse rate
- B. Speed
- C. Wavelength
- D. Frequency

T5A12 HRLM (2-1)



What term describes the number of times per second that an alternating current reverses direction?

- A. Pulse rate
- B. Speed
- C. Wavelength
- D. Frequency**

T5A12 HRLM (2-1)



Which instrument would you use to measure electric potential or electromotive force?

- A. An ammeter
- B. A voltmeter
- C. A wavemeter
- D. An ohmmeter

T7D01 HRLM (3-1)



Which instrument would you use to measure electric potential or electromotive force?

- A. An ammeter
- B. A voltmeter**
- C. A wavemeter
- D. An ohmmeter

T7D01 HRLM (3-1)



What is the correct way to connect a voltmeter to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D02 HRLM (3-3)

What is the correct way to connect a voltmeter to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit**
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D02 HRLM (3-3)

How is an ammeter usually connected to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D03 HRLM (3-3)

How is an ammeter usually connected to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D03 HRLM (3-3)

Which instrument is used to measure electric current?

- A. An ohmmeter
- B. A wavemeter
- C. A voltmeter
- D. An ammeter

T7D04 HRLM (3-1)



Which instrument is used to measure electric current?

- A. An ohmmeter
- B. A wavemeter
- C. A voltmeter
- D. An ammeter**

T7D04 HRLM (3-1)

What instrument is used to measure resistance?

- A. An oscilloscope
- B. A spectrum analyzer
- C. A noise bridge
- D. An ohmmeter

T7D05 HRLM (3-4)

What instrument is used to measure resistance?

- A. An oscilloscope
- B. A spectrum analyzer
- C. A noise bridge
- D. An ohmmeter**

T7D05 HRLM (3-4)

Which of the following might damage a multimeter?

- A. Measuring a voltage too small for the chosen scale
- B. Leaving the meter in the milliamps position overnight
- C. Attempting to measure voltage when using the resistance setting
- D. Not allowing it to warm up properly

T7D06 HRLM (3-3)

Which of the following might damage a multimeter?

- A. Measuring a voltage too small for the chosen scale
- B. Leaving the meter in the milliamps position overnight
- C. Attempting to measure voltage when using the resistance setting**
- D. Not allowing it to warm up properly

T7D06 HRLM (3-3)

Which of the following measurements are commonly made using a multimeter?

- A. SWR and RF power
- B. Signal strength and noise
- C. Impedance and reactance
- D. Voltage and resistance

T7D07 HRLM (3-3)

Which of the following measurements are commonly made using a multimeter?

- A. SWR and RF power
- B. Signal strength and noise
- C. Impedance and reactance
- D. Voltage and resistance**

T7D07 HRLM (3-3)



Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter?

- A. Ensure that the applied voltages are correct
- B. Ensure that the circuit is not powered
- C. Ensure that the circuit is grounded
- D. Ensure that the circuit is operating at the correct frequency

T7D11 HRLM (3-3)



Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter?

- A. Ensure that the applied voltages are correct
- B. Ensure that the circuit is not powered**
- C. Ensure that the circuit is grounded
- D. Ensure that the circuit is operating at the correct frequency

T7D11 HRLM (3-3)



Which of the following precautions should be taken when measuring high voltages with a voltmeter?

- A. Ensure that the voltmeter has very low impedance
- B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured
- C. Ensure that the circuit is grounded through the voltmeter
- D. Ensure that the voltmeter is set to the correct frequency

T7D12 HRLM (3-3)

Which of the following precautions should be taken when measuring high voltages with a voltmeter?

- A. Ensure that the voltmeter has very low impedance
- B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured**
- C. Ensure that the circuit is grounded through the voltmeter
- D. Ensure that the voltmeter is set to the correct frequency

T7D12 HRLM (3-3)

