Technician License Course
Chapter 3

Lesson Plan Module 4 –
Electricity

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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.

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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

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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

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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).

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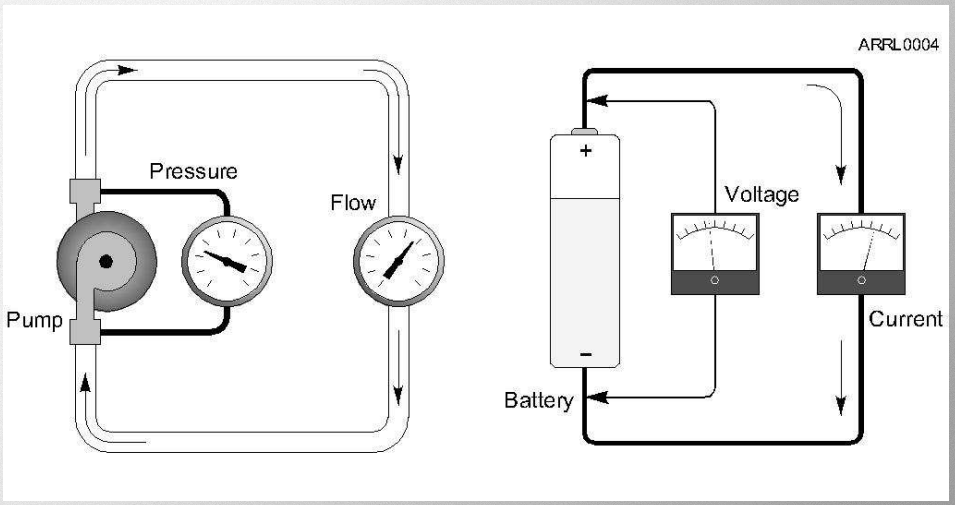
Basic Electrical Concepts

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



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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).

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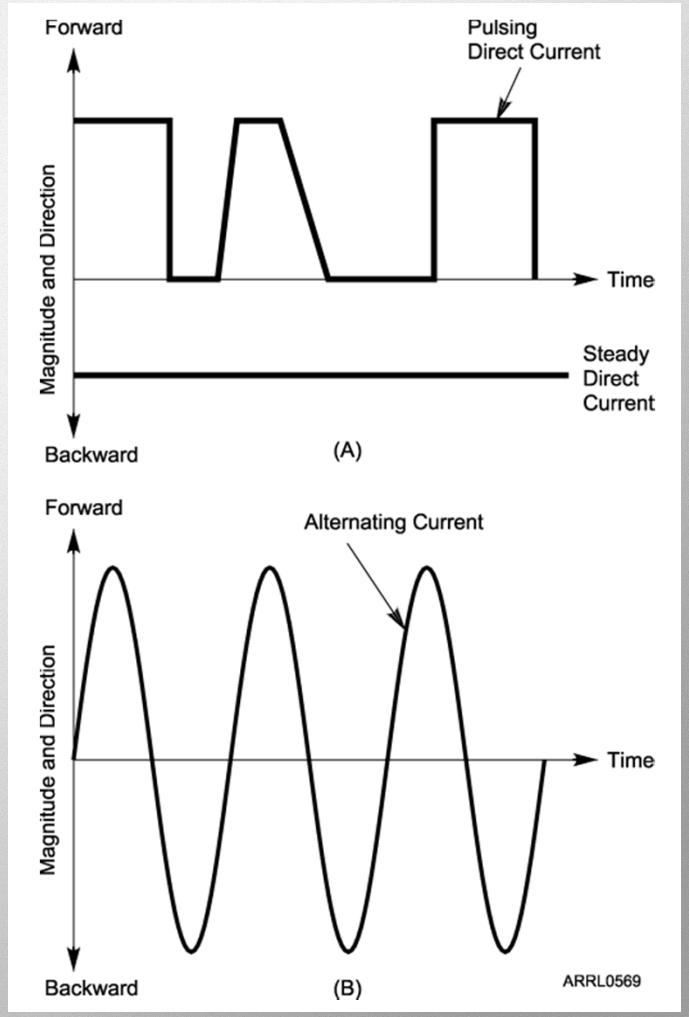
The Two Kinds of Current

- 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



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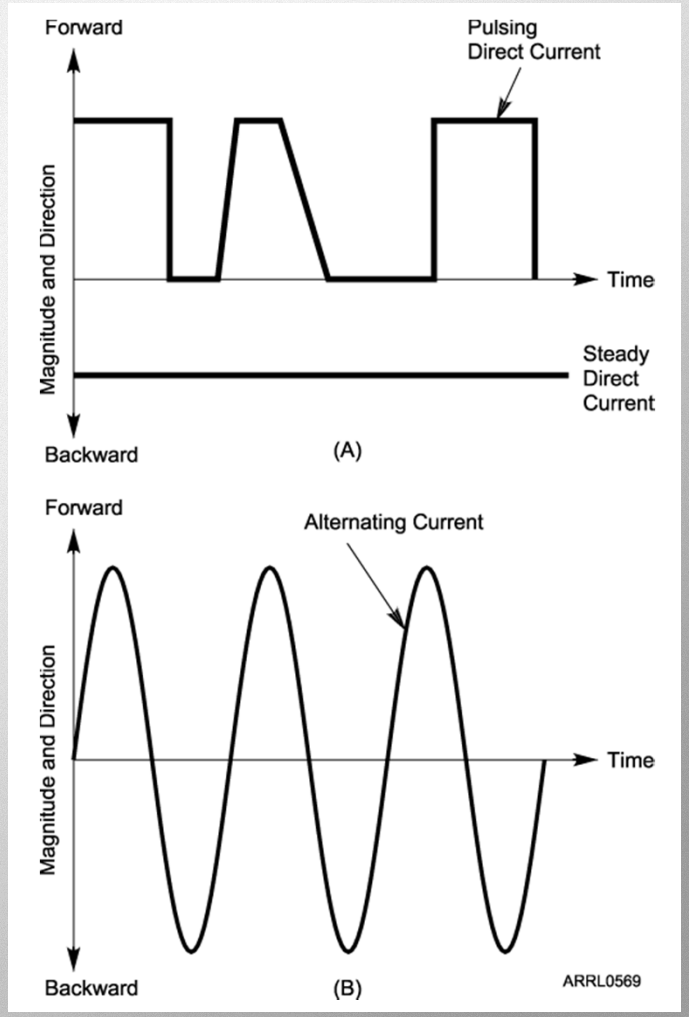
The Two Kinds of Current

- 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



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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

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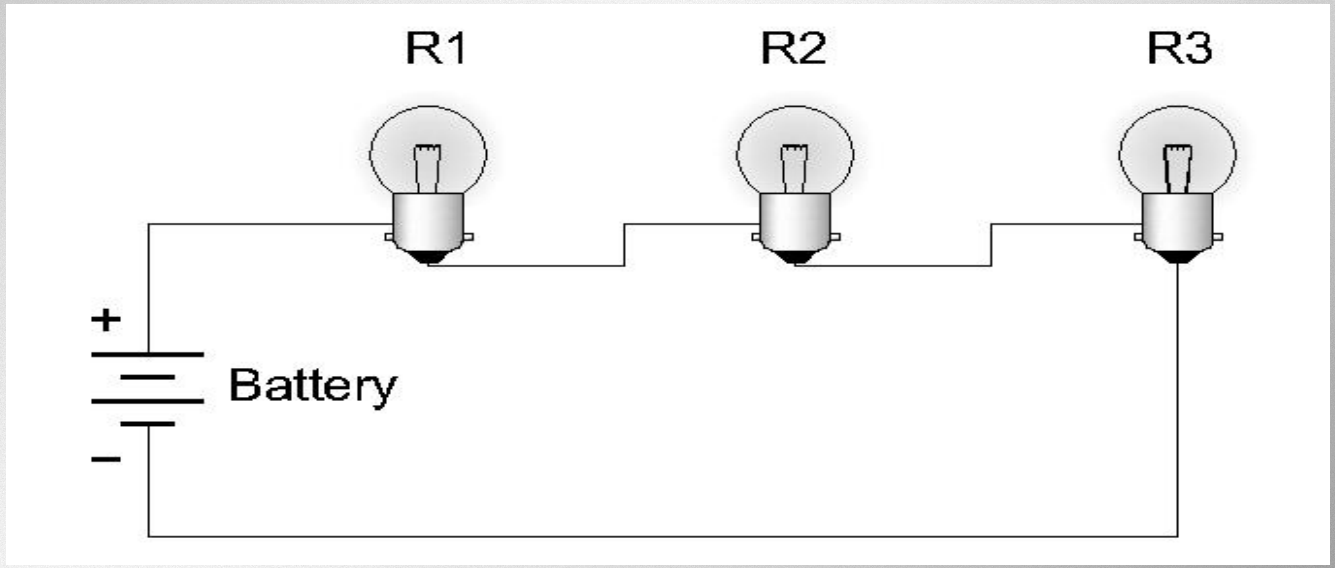
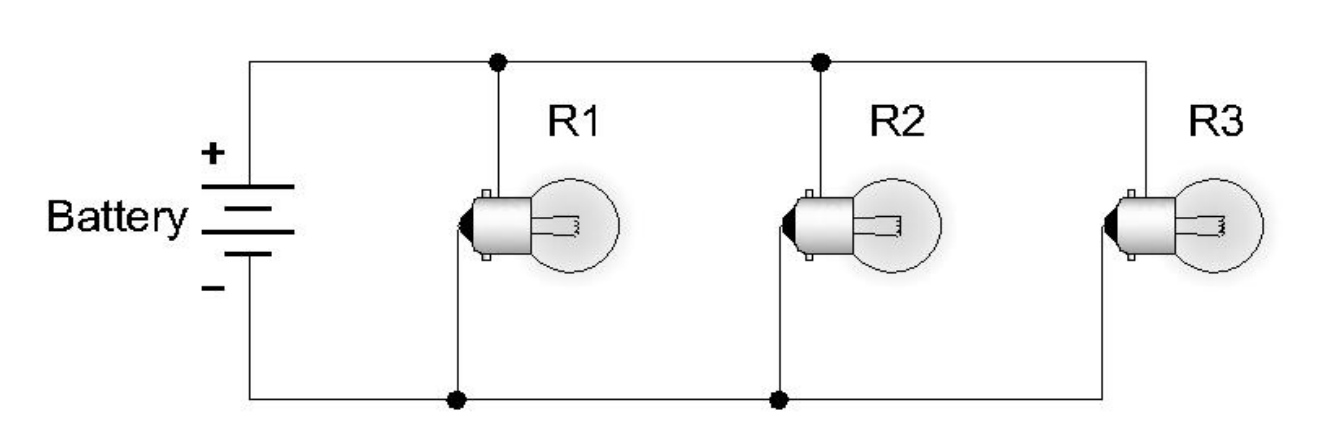
Series Circuits

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



Parallel Circuits

- Parallel circuits provide multiple paths for current flow.



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Practice Questions

Electrical current is measured in which of the following units?

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

T5A01 HRLM (3-1)

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Electrical current is measured in which of the following units?

A. Volts

B. Watts

C. Ohms

D. Amperes

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

A. Voltage

B. Resistance

C. Capacitance

D. Current

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

A. Voltage

B. Resistance

C. Capacitance

D. Current

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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)

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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)

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What is the basic unit of electromotive force?

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

T5A11 HRLM (3-1)

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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)

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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)

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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)

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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)

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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)

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Which instrument is used to measure electric current?

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

T7D04 HRLM (3-1)

ARRL The national association for AMATEUR RADIO

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)

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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)

ARRL The national association for AMATEUR RADIO

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)

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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)

ARRL The national association for AMATEUR RADIO

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)

ARRL The national association for AMATEUR RADIO

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)

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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)

ARRL The national association for AMATEUR RADIO

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)

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