

Automotive Electrical Systems

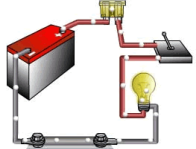
Electrical Components

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Brookhaven College

Automotive Electrical Systems

Circuit Components

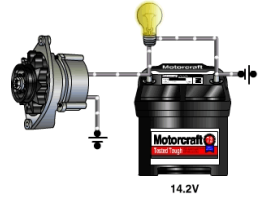
- Power Source
- Conductor
- Load
- Switch
- Circuit Protection



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Power Source

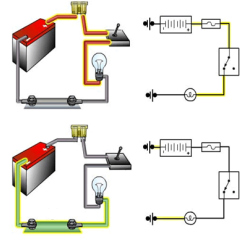
- Automobiles usually use the battery and/or alternator as the power source
- The battery converts chemical energy into electrical energy
- The alternator is used to operate electrical accessories and charge the battery when the engine is running



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Conductor

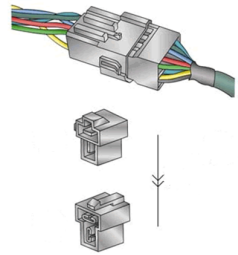
- The conductor's ability to carry current is affected by atomic structure, length, diameter and temperature
- Many automotive circuits use the vehicle's frame, body and/or powertrain to complete the circuit



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Connectors

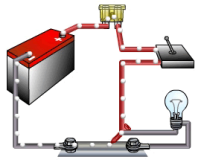
- Connectors allow multiple wires to be connected at one time
- Connectors connect wiring to a component, another wiring harness
- Connectors also provide easy access points for diagnosis, disassembly, and repair



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Circuit Protection

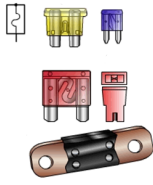
- A circuit is protected from damage by limiting maximum current flow with:
 - Fuses
 - Circuit breakers
 - Fusible links
 - Thermal limiters



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Fuses

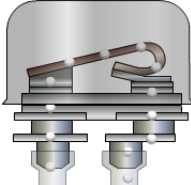
- Fuses melt or open when the current exceeds the fuse's rated limit
- Common types of automotive fuses
 - Standard blade type or Auto-fuse
 - Miniature blade type or Mini-fuse
 - High current or Maxi-fuse
 - Cartridge fuse
 - Mega-fuse



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Circuit Breakers

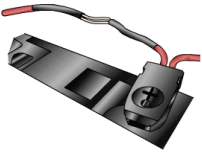
- Circuit breakers are used on circuits that are susceptible to overloads
 - Non-cycling circuit breakers will reset only when the problem is corrected or the circuit is powered down
 - Cycling circuit breakers cycle open and closed until the problem is corrected



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Fusible Links

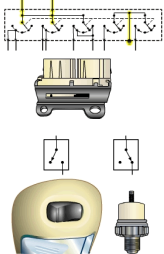
- A fusible link is a short length of wire, normally two gauge sizes smaller than the circuit's wiring and made of a copper alloy that has a low melting point
- Fusible links generally are used to protect large portions of a vehicle's wiring where fuses and circuit breakers are not practical
- Fuse links are color coded to indicate size and wire gauge



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Switches

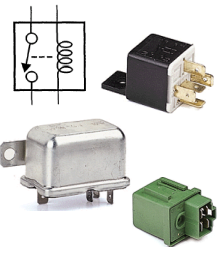
- Switches are used to control circuit operation
- Switches may be directly or indirectly controlled
 - Single pole single throw
 - Single pole double throw
 - Ganged switch
 - Momentary contact
 - Temperature operated
 - Pressure operated
 - Position operated
- Normally-closed verses normally-open



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Relays

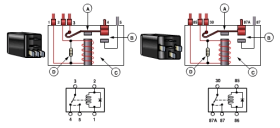
- A relay is a remote electrical switch that uses a small current to control a larger current
- The small amount of current is used to create a magnetic field and open or close a higher current circuit
 - Control side – low current
 - Load side – high current



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Relay Operation

- A relay consists of an electromagnet, an armature, a set of contacts and some contain a clamping diode
- Normally open verses normally closed

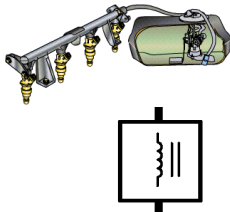


A - armature
B - contacts
C - electromagnet
D - clamping diode

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Solenoids

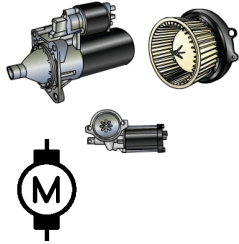
- Solenoids use electromagnetism to move a soft iron core and perform work
- Examples include:
 - Fuel injectors
 - Vacuum control solenoids
 - Trunk release solenoids
 - Starter motor solenoid



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Electric Motors

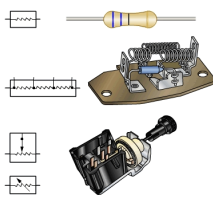
- Motors convert electrical energy into mechanical action
- The motors use the interaction of magnetic fields to convert electrical energy into mechanical energy
- Some examples of motors are power window, starter, and blower motors



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Resistors

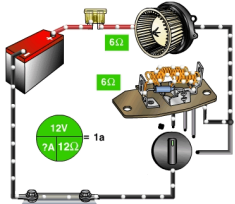
- Resistors are used to add a calibrated voltage drop to a circuit
- The voltage drop can be used to control a load's operation, protect a circuit or to provide an input to a module
 - Resistor
 - Stepped resistor
 - Rheostat
 - Potentiometer



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Stepped Resistors

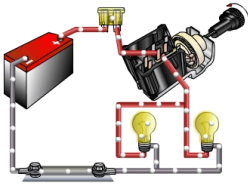
- Stepped resistors allow two or more fixed value resistors to be placed in series to control load operation
- Selecting different switch positions on the control panel adds or subtracts resistors in series



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Rheostat

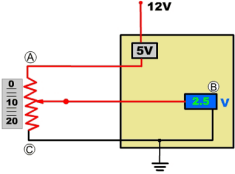
- Rheostats are used as a variable resistor increase or decrease the voltage available to the circuit's load



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Potentiometers

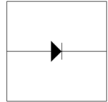

- A potentiometer uses a variable resistor to provide a voltage signal to indicate the wiper's position to a module or computer



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Diodes

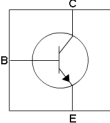
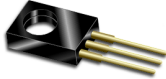
- A diode is the simplest of semiconductor devices
- A single PN junction to acts as a one way electrical check valve
 - Forward biased
 - Reverse biased
 - Anode verses cathode
- Diodes are commonly used to protect circuits and rectify AC voltage

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Transistors

- Transistors use two PN junctions and act as a variable solid state relay
 - Collector
 - Base
 - Emitter
- NPN verses PNP





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Capacitors

- Capacitors are used to absorb and store electrical charges
- Composed of two or more conducting plates with non-conducting material between them
- Capacitors are used to absorb voltage spikes
 - To prevent arcing
 - Serve as a noise filter
- Capacitors are measured in units called Farads

NON-POLARIZED CAPACITOR



POLARIZED CAPACITOR



VARIABLE CAPACITOR

