Basic electrical system Components

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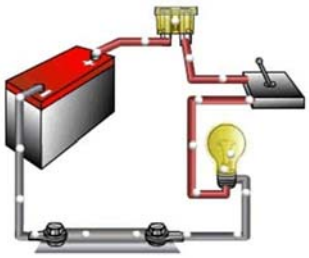
Automotive Electrical Systems

Basic circuit components

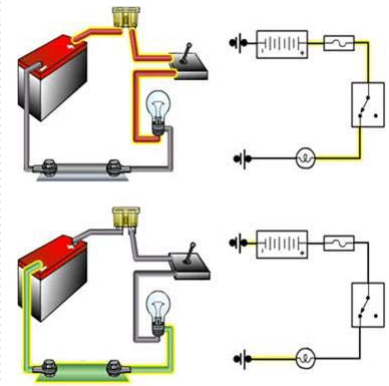


- Power supply
- Circuit protection
- Conductor
- Load
- Switch

Power source

- Automobiles use two basic sources for electrical power.
- Battery: uses chemical reactions to produce a voltage used during KOEO ,engine starting and high load KOER.
- Alternator: uses rotational force from the engine to produce voltage to operate the automobile while running and recharge the battery.

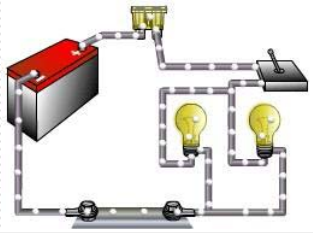
Conductors



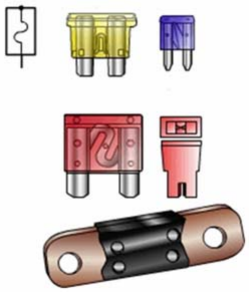
- The conductors are used to transfer the electrical power to the loads throughout the automobile.
- Various conductors include: copper wiring, vehicle frame, vehicle body, powertrain, and module casings.
- There are situations where high resistance conductors are necessary: blower motor resistors and cooling fan resistors.

Circuit protection

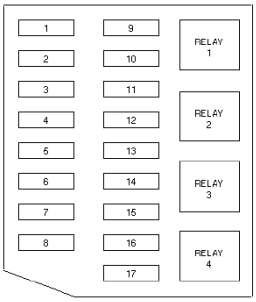
- Provides a limiter for situations where too much amperage may flow through the conductors.
- Rated in AMPS.
- Types:
  - Fuses
  - Circuit breaker
  - Fusible link
  - Thermal limiters



Fuses



- Fuses have a thin strip of material that once heated by high amperage it melts creating an open circuit.
- Common types used:
  - Standard Blade
    - Auto-fuse
  - Miniature Blade
    - Mini-fuse
  - High amperage
    - Maxi-fuse
  - Mega-fuse
  - Fusible link cartridge



RELAY NUMBER	NAME
1	Rear Defrost Relay
2	Horn Relay
3	Cooling Fan Relay
4	Air Suspension Pump Relay
*4	Police Power Relay

MAXI-FUSE	AMPS	CIRCUITS PROTECTED	PAGE
8	30	Air Suspension System	13-4
9	50	Ignition Switch Feed to Central Junction Box Fuses 5,9	13-7
10	50	Ignition Switch Feed to Central Junction Box Fuses 1,2,6,7,10,11,13 and Circuit Breaker 14	13-8
11	40	Central Junction Box Fuses 4,8,16 and Circuit Breaker 12	13-6
12	30	PCM Power Relay, PCM, Natural Gas Vehicle Module	13-5
13	50	High Speed Cooling Fan Relay	13-1
14	40	Rear Window Defrost, Central Junction Box Fuse 17	13-6
15	50	Anti-Lock Brake Module	13-5
*16	50	Police Option Fuse Holder	13-2
FUSE	**AMPS**	**CIRCUITS PROTECTED**	**PAGE**
1	20	Electric Fuel Pump Relay	13-5
2	30	Starter Relay, Generator, Ignition Switch Feed to Central Junction Box Fuses 15,18	13-7
3	25	Radio, Subwoofer Amplifier, and CD Changer	13-2
*4	30	Police Power Relay	13-2
5	15	Horn Relay	13-2
6	20	DRL Module	13-5
CIRCUIT BREAKER	**AMPS**	**CIRCUITS PROTECTED**	**PAGE**
7	20	Power Door Locks, Power Seats, and Luggage Compartment Lid Release	13-3
17	30	Cooling Fan Low Relay	13-6

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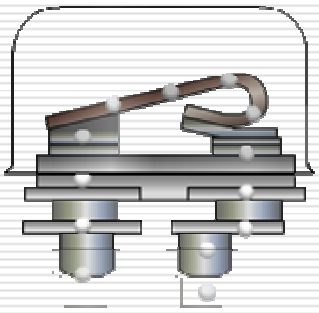
Circuit Breaker

- Circuit Breakers are used on circuits that commonly see high amperage. (not normal)
- Types:
  - Non-cycling circuit breakers once the amperage exceeds a set amount the breaker opens the circuit until the operator resets it.
  - Cycling circuit breaker will reset once the breaker cools. If the circuit is still in fault the breaker will reopen upon the high amperage



Fusible link

- Slow circuit protection.
- Excessively high amperage loads are needed for the link to create an open circuit.
- Short term short circuits are not enough to create an open circuit. (ie. Wrench grounding to frame)
- Also used in situations where high amperage might be common for short periods of time.

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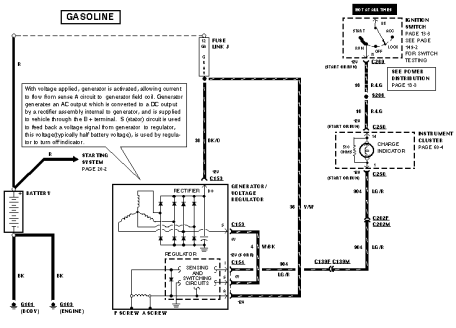
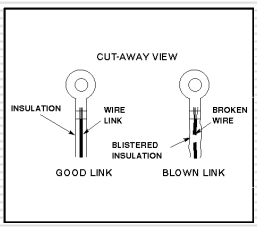
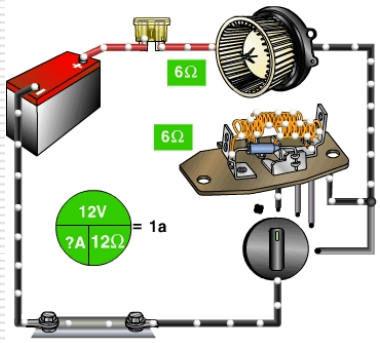
Fusible link



FUSIBLE LINK COLOR CODING	
WIRE LINK SIZE	INSULATION COLOR
20 GA	Blue
18 GA	Brown or Red
16 GA	Black or Orange
14 GA	Green
12 GA	Gray

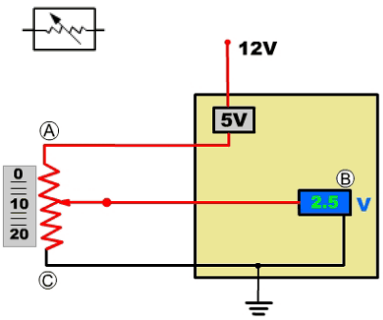


Stepped Resistors

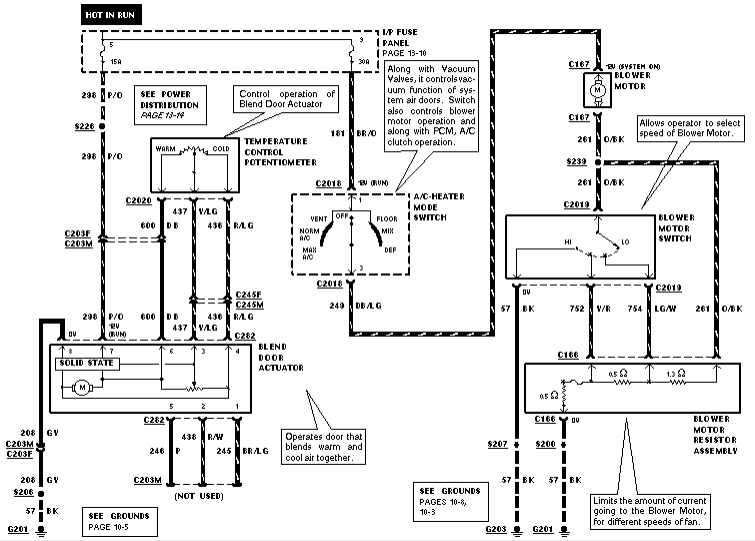


- Stepped resistors allow two or more fixed value resistors to be placed in series to control load operation (speed or illumination)
- Selecting different switch positions on the control panel adds or subtracts resistors in series.

Potentiometer

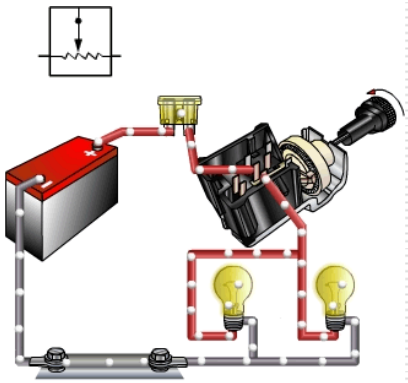


- A potentiometer uses a variable resistor to provide a voltage signal to indicate the wiper's position to a module or computer
- Not in series with a load.
- Circuits associated:
  - A. VREF (normally 5 volts.
  - B. Signal (varies 0 to 5 volts)
  - C. Signal Return (basically a monitored Ground)



Rheostat

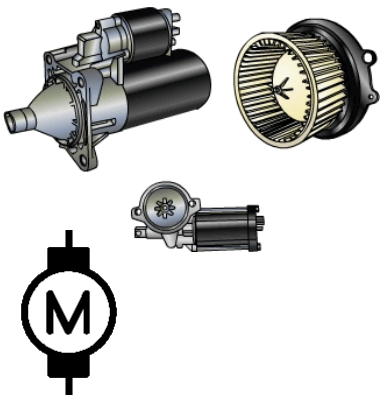
- Variable resistor used in series with loads to control the amount of voltage supplied to the load. (continuously variable)



Diodes

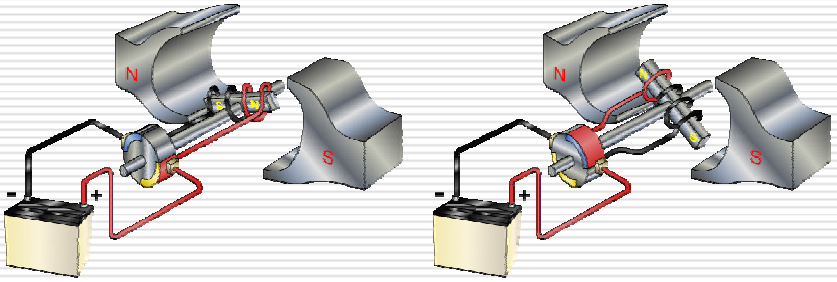
- Semiconductor used to control the flow electricity.
- One way electrical valve
- Diodes are used to "clamp voltage spikes" for circuit protection.
- Diodes are used to "rectify" AC voltage produced by the alternator. Converts AC to DC for vehicle operation.

Electric motors



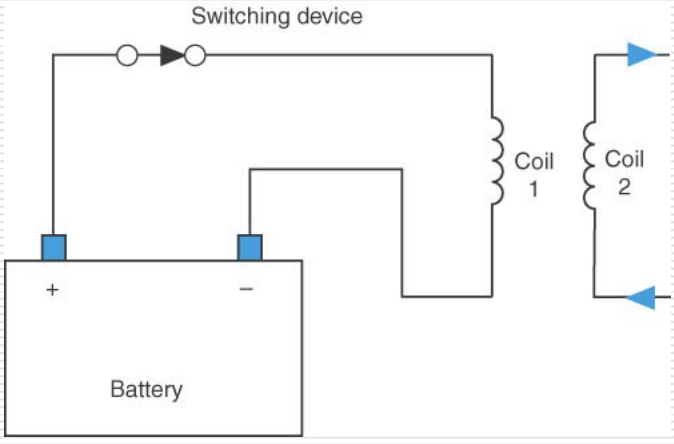
- Electrical motors convert electrical energy into mechanical action.
- The motors use the forces involved with magnetic fields to create a rotational torque.

Change of magnetic poles

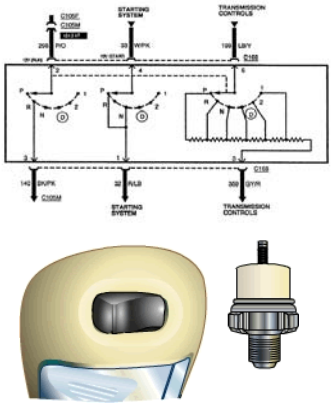


Ignition coil/ AC clutch coil

- An ignition coil is used to create high voltage spikes for spark during ignition operation. Converts @13v to 40Kv.
- AC clutch coil is used to produce a magnetic field to apply a clutch plate onto a clutch pulley. It converts @13v into @300 volts.



Switches



- Switches are used to control circuit operation.
- Types:
  - Single pole single throw
  - Single pole double throw
  - Ganged switch
  - Momentary contact
  - Temperature activated
  - Pressure activated
  - Position activated

Mercury Switches

- Contains a capsule partially filled with mercury which makes or brakes contact when switch is tipped.

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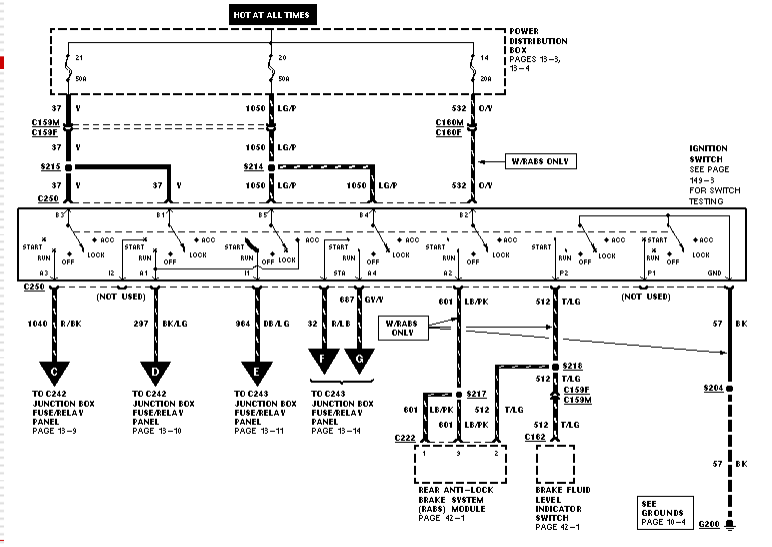
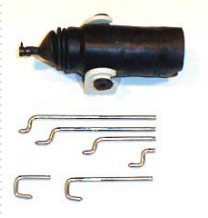


Solenoids.



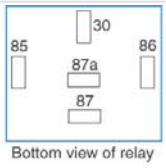
- Solenoids are use to perform some mechanical function.
- Will also produce voltage spikes due to there design.

Relays

- Relays are used to control a high amperage circuit with a low amperage control from a module or switch.
- The low amperage circuit is used to create a magnetic field to close or open contacts on the high amperage circuit.
- Types:
  - Standard mini-ISO 5pin relay
  - Micro-ISO 5 pin
  - Symmetrical 4 pin

* International Standards Organization

Relays



Bottom view of relay