

Technician License Course Chapter 3

Lesson Plan Module 6 – Electrical Components



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Electronics – Controlling the Flow of Current

- To make an electronic device (like a radio) do something useful (like a receiver), we need to control and manipulate the flow of current.
- There are a number of different electronic components that are used to do this.

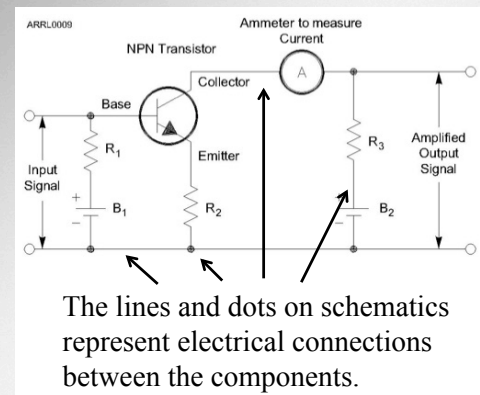
Schematic Diagrams

- We can draw pictures of electronic components forming circuits, such as for the parallel and series circuit examples. This is too cumbersome for most circuits.
- Schematic diagrams use symbols with different components, each having a different symbol.



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Schematic Diagrams



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The Resistor

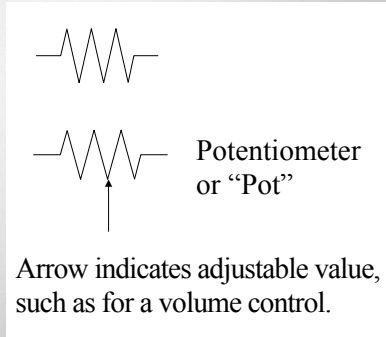
- The function of a resistor is to restrict the flow of current.

- Remember Ohm's Law:

$$I = E / R$$

$$E = I \times R$$

- Schematic symbol



Arrow indicates adjustable value, such as for a volume control.



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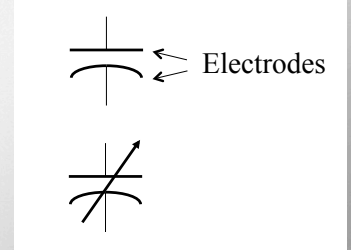
The Capacitor

- The function of a capacitor is to store electrical energy – called *capacitance*.

- Acts like a battery

- Stores energy in an electric field created by voltage between the electrodes with insulating *dielectric* material between them

- Schematic symbol



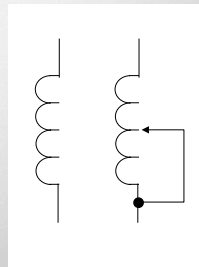
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The Inductor

- The function of an inductor is to store magnetic energy – called *inductance*.

- A coil of wire around a *core* of air or magnetic material like iron or ferrite
- Stores energy in a magnetic field created by current in the wire

- Schematic symbol



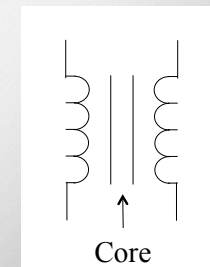
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The Transformer

- A pair of inductors sharing a common core

- Also share their magnetic field
- Used to transfer energy from one circuit to another without a direct connection
- Changes the ratio of voltage and current

- Schematic symbol



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Electrical Units

- Each type of component has a value measured in specific units:
 - Resistors > resistance > ohms (Ω)
 - Capacitors > capacitance > farads (F)
 - Inductors > inductance > henrys (H)



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Component Designators

- Each schematic symbol has a *designator* to denote which component it refers to. For example, the 10th resistor in a circuit is R10.
- Resistors (R), capacitors (C), inductors (L).



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Indicators and Displays

- Indicators communicate status
 - ON/OFF, ready/stand-by, left/right
 - LEDs, light bulbs, symbols, audio tones
- Displays communicate values or text
 - Numeric values, warnings, messages
 - Digital and analog meters, LCD screens



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Reactance

- Capacitors and inductors store energy, rather than dissipating it like resistors.
- Energy storage creates an effect called *reactance* (symbol X) that acts like a resistance in opposing the flow of ac current.
 - Capacitors create *capacitive reactance* (X_C)
 - Inductors create *inductive reactance* (X_L)
 - The effects of each are complementary



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Impedance

- The combination of resistance (R) and reactance (X) is called *impedance*, represented by the symbol Z .
- Impedance represents a circuit's opposition to both ac and dc currents.



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Resonance

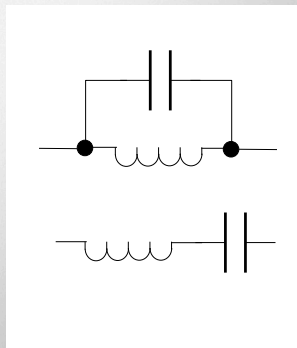
- A component's reactance depends on frequency: X_L increases with frequency while X_C decreases.
- At the frequency for which a circuit's X_L and X_C are equal, their effects cancel. This is the circuit's *resonant frequency*.
- At *resonance*, a circuit has only resistance, which affects ac and dc current equally.



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Resonant or Tuned Circuit

- Capacitors and inductors connected together create a *tuned circuit*.
 - When X_L and X_C are equal, the circuit is *resonant*.
 - If C or L are adjustable the resonant frequency can be varied or tuned.



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Semiconductor Components

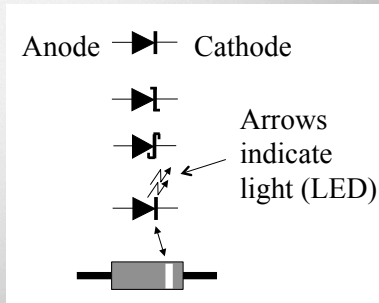
- Made of material like silicon that are “OK” conductors but not as good as metals.
- Impurities added to semiconductors create material with more than usual electrons (*N-type*) and fewer than usual (*P-type*) electrons.
- Structures of N and P material can control current flow through the semiconductor.



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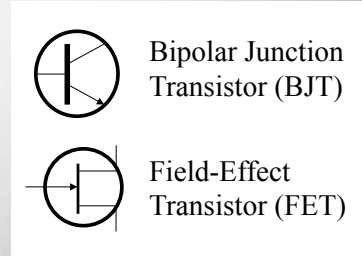
The Diode

- Allows current to flow in only one direction.
- Schematic symbol
- Designator (D or CR)
 - Two electrodes: *anode* and *cathode*
 - AC current is changed to varying pulses of dc – called *rectification*
 - Diodes used to change ac power to dc power are called *rectifiers*



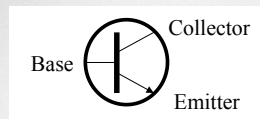
The Transistor

- The function of a transistor is to control large signals with small ones.
 - An “electronically controlled current valve”
 - When used as an amplifier a transistor produces *gain*
 - Transistors can also be used as a switch
- Schematic symbol
- Designator (Q)
 - Bipolar Junction Transistor (BJT)
 - Field-Effect Transistor (FET)



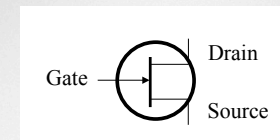
The Transistor

- The Bipolar Junction Transistor (BJT) has three layers of N or P material connected to electrodes:
 - Base
 - Collector
 - Emitter
- Depending on the arrangement of layers, a BJT is either an NPN or PNP transistor.



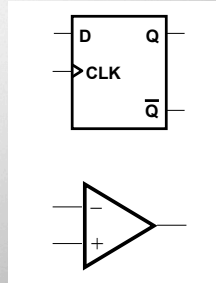
The Transistor

- The Field-Effect Transistor (FET) has a conducting path or channel of N and P material connected to the drain and source electrodes.
 - Gate
 - Drain
 - Source
- Voltage applied to the gate electrode controls current through the channel.



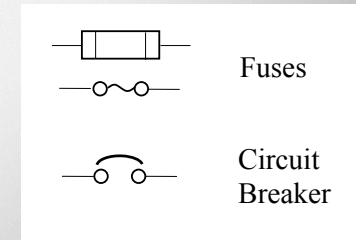
The Integrated Circuit

- The integrated circuit is a collection of components contained in one device that accomplishes a specific task.
- Schematic symbol
- Designator (IC or U)



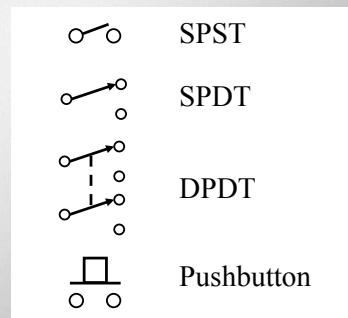
Protective Components

- Fuses and circuit breakers are designed to remove power in case of a circuit overload.
 - Fuses blow – one time protection
 - Circuit breakers trip – can be reset and reused
 - Always use proper rating
- Schematic symbol
- Designator (F or CB)



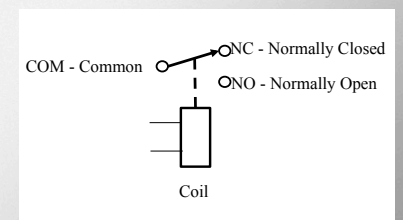
Switches

- Switches are used to interrupt or allow current to flow.
- Schematic symbol
- Designator (S or SW)
 - Each circuit controlled by the switch is a *pole*
 - Each position is called a *throw*



Relays

- Relays are switches activated by current in a coil (electromagnet)
 - Relays use the same pole/throw names as switches
 - The moving switch is called the *armature*
 - *Contacts* are named by when they are connected
- Schematic symbol
- Designator (K or RLY)



Other Circuit Symbols

