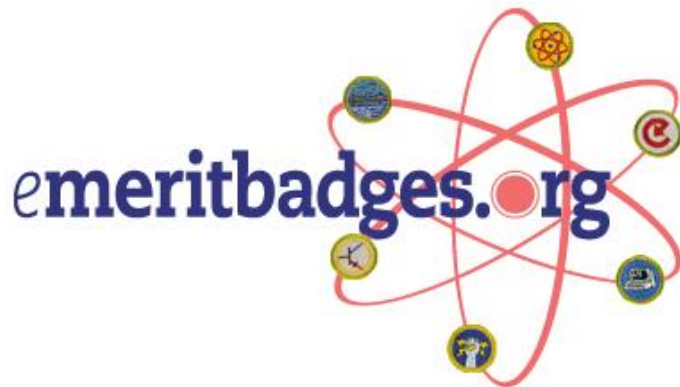




Electronics Merit Badge

Class session 2

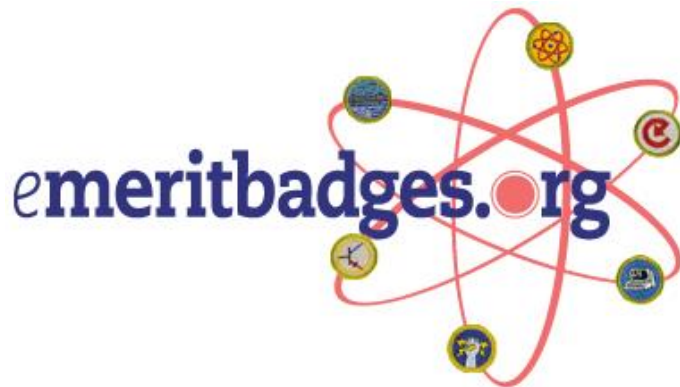




Electronics Merit Badge

Electronics test and measurement

Requirement 5B

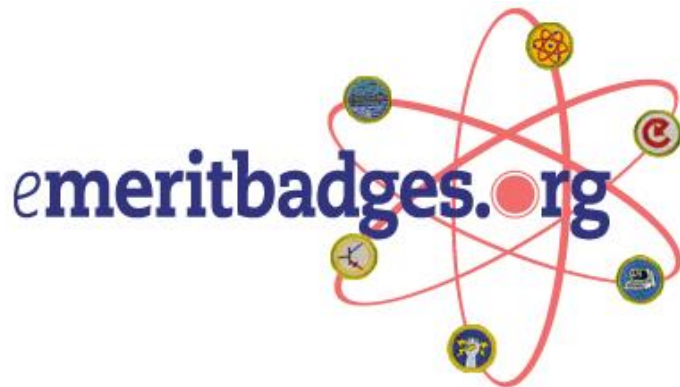




Requirement 5B

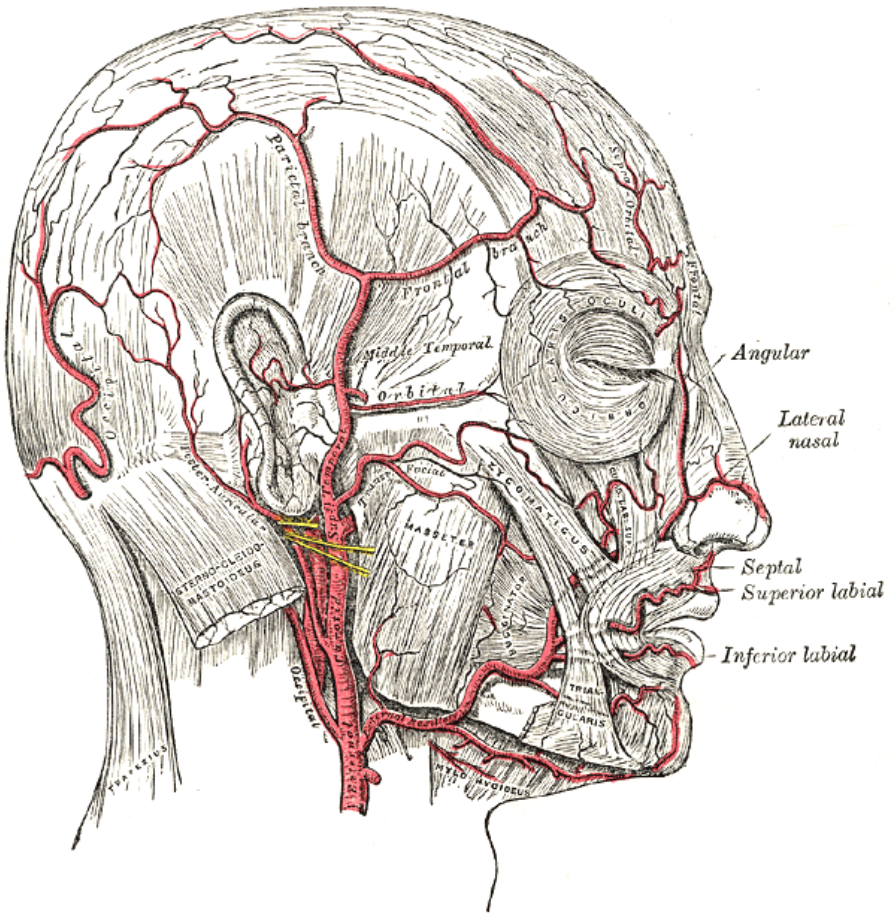
Tell about the need for and the use of test equipment in electronics.

Name three types of test equipment. Tell how they operate-how they are used.



Two of the most important kinds of equipment

Your Brain



A brain assistant.



Equipment Used

Volt/Ohm/Amp Meter or Multimeter

Usually referred to as a **DVM**.

With this we can measure current, voltage and resistance.



Oscilloscope

Usually referred to as scope.

With this we can 'see' voltages.

This is very useful when voltage is changing, as a meter is no good to us when this is happening.



Equipment Used

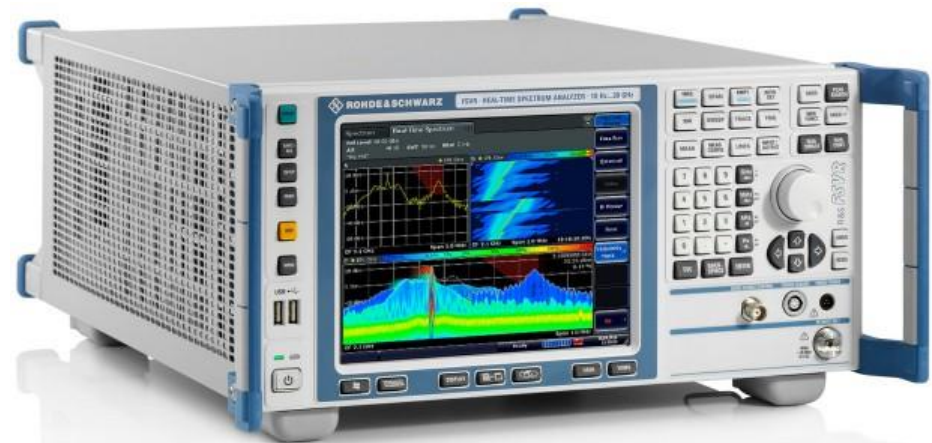


Digital Logic Probe

Used to check the logic state (High/Low) of a digital circuit.

Spectrum Analyzer

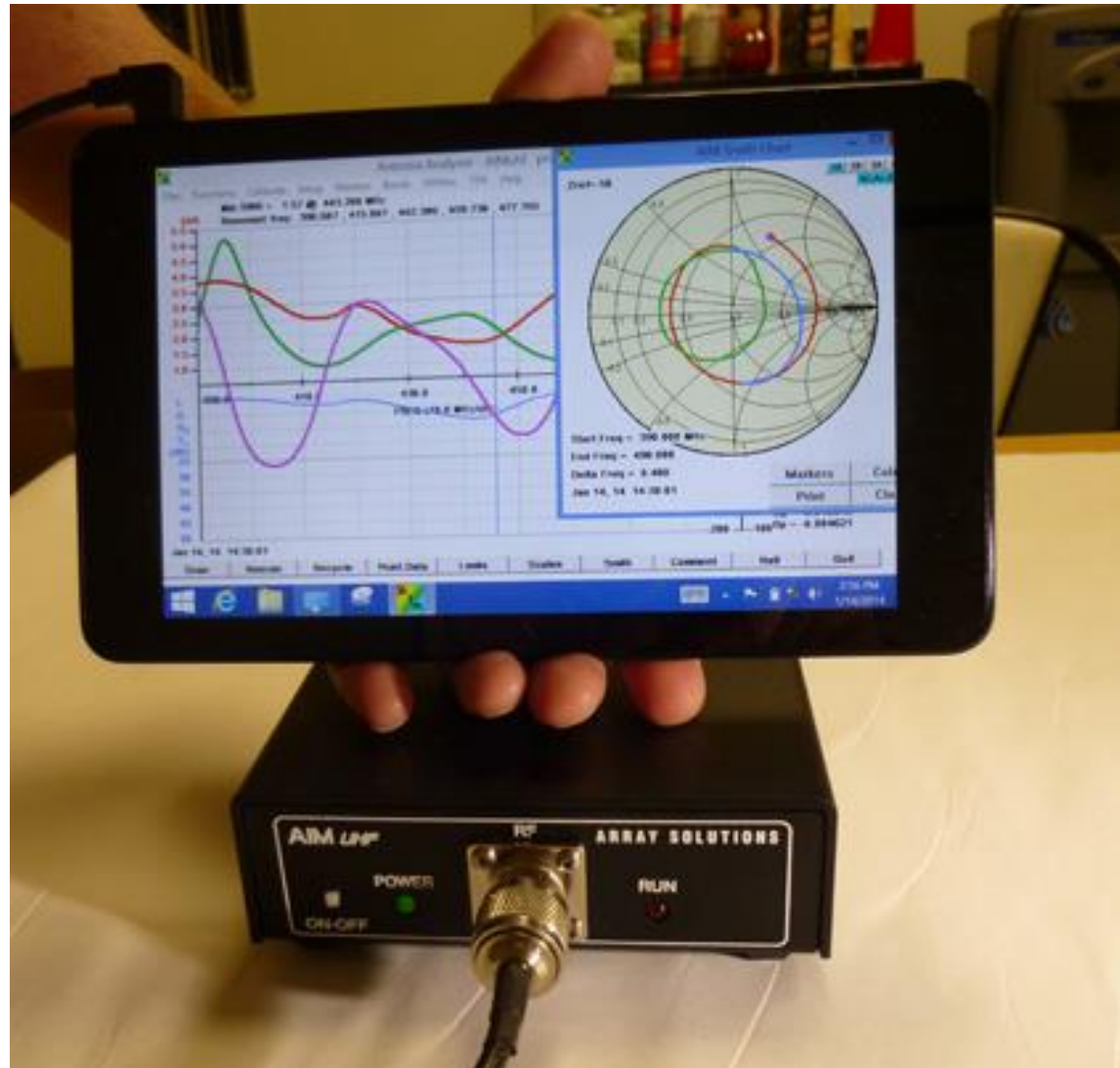
Used to measure the magnitude of an input signal versus its frequency within the full frequency range of the instrument.



Equipment Used

RF Analyzer

Used for measuring the condition of antennas, transmission lines and overall radio system performance





Electronics Merit Badge

Electronic signals demonstration

By Bill Byrom





Requirement 5B

Tell about the need for and the use of test equipment in electronics.

Name three types of test equipment. Tell how they operate-how they are used.

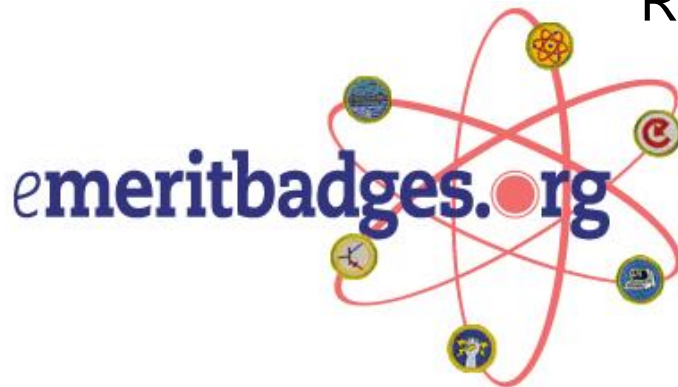




Electronics Merit Badge

Schematic Drawings and how components work

Requirement 2A



DC Circuit Wiring

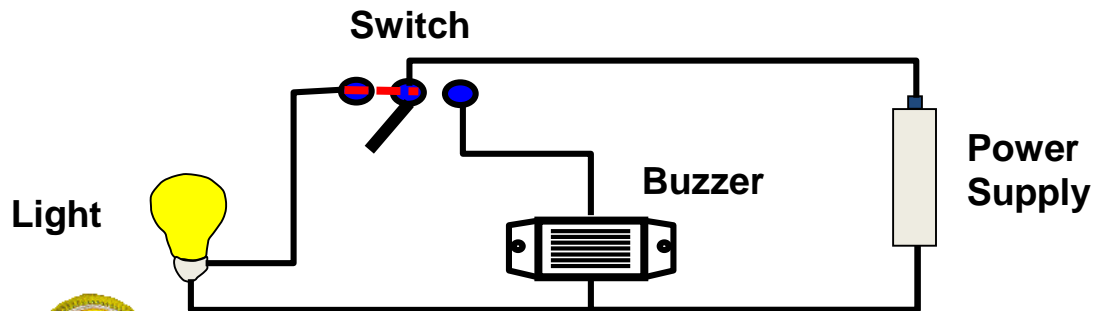
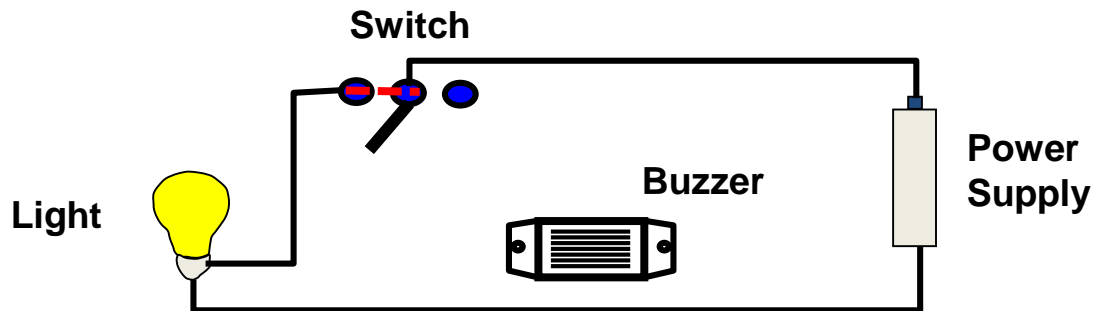
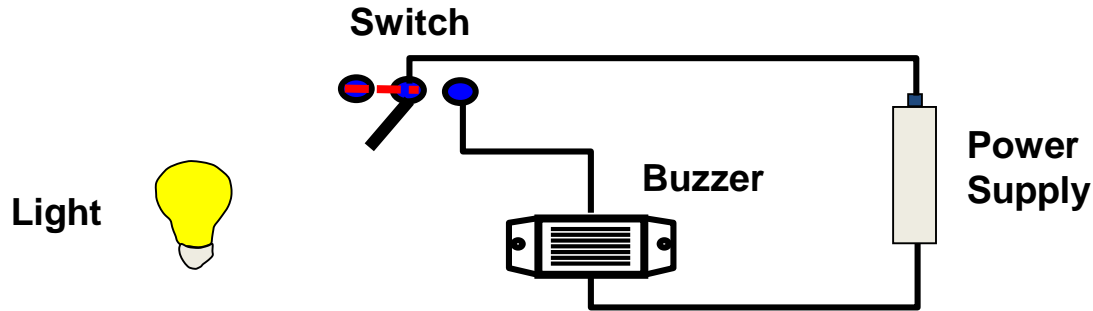
Requirement 2A

What does the
term “Circuit”
mean?



DC Circuit Wiring

Requirement 2A



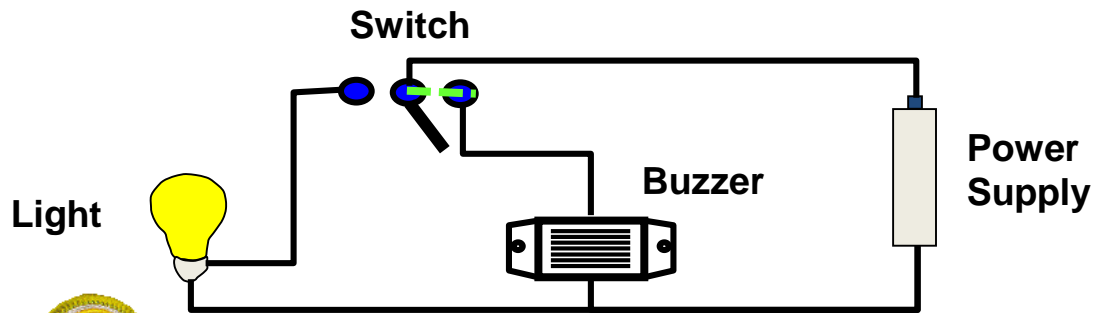
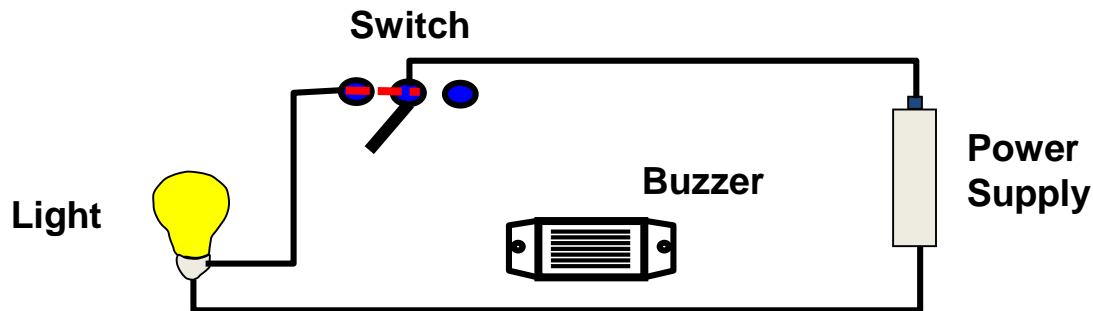
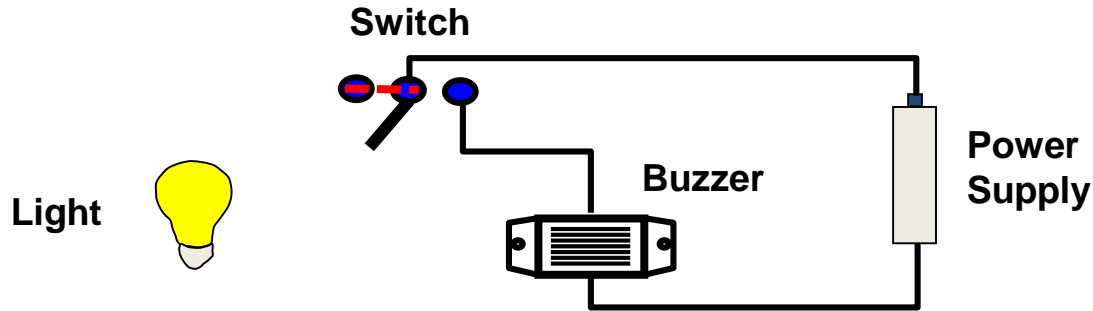
Definition of Circuit;

- A circular journey or one beginning and ending at the same place; a round.
- Electrical current must flow in such a way that it returns to the source.



DC Circuit Wiring

Requirement 2A



Definition of Circuit;

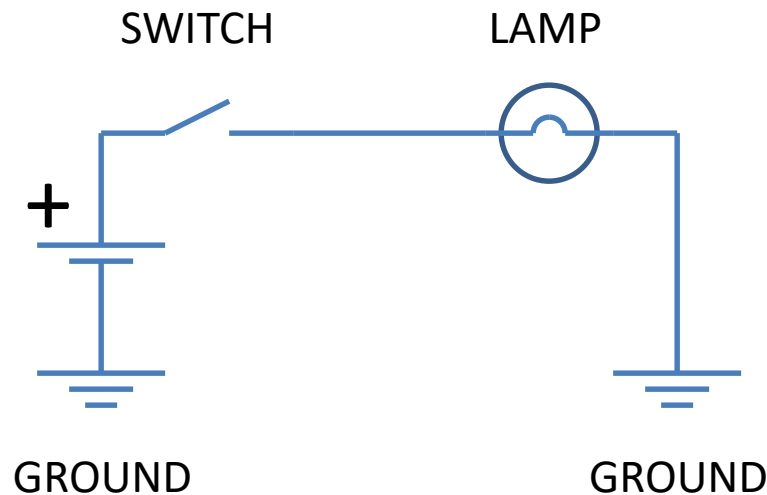
- A circular journey or one beginning and ending at the same place; a round.
- Electrical current must flow in such a way that it returns to the source.



CIRCUIT DIAGRAM (SCHEMATIC)

Requirement 2A

FLASHLIGHT

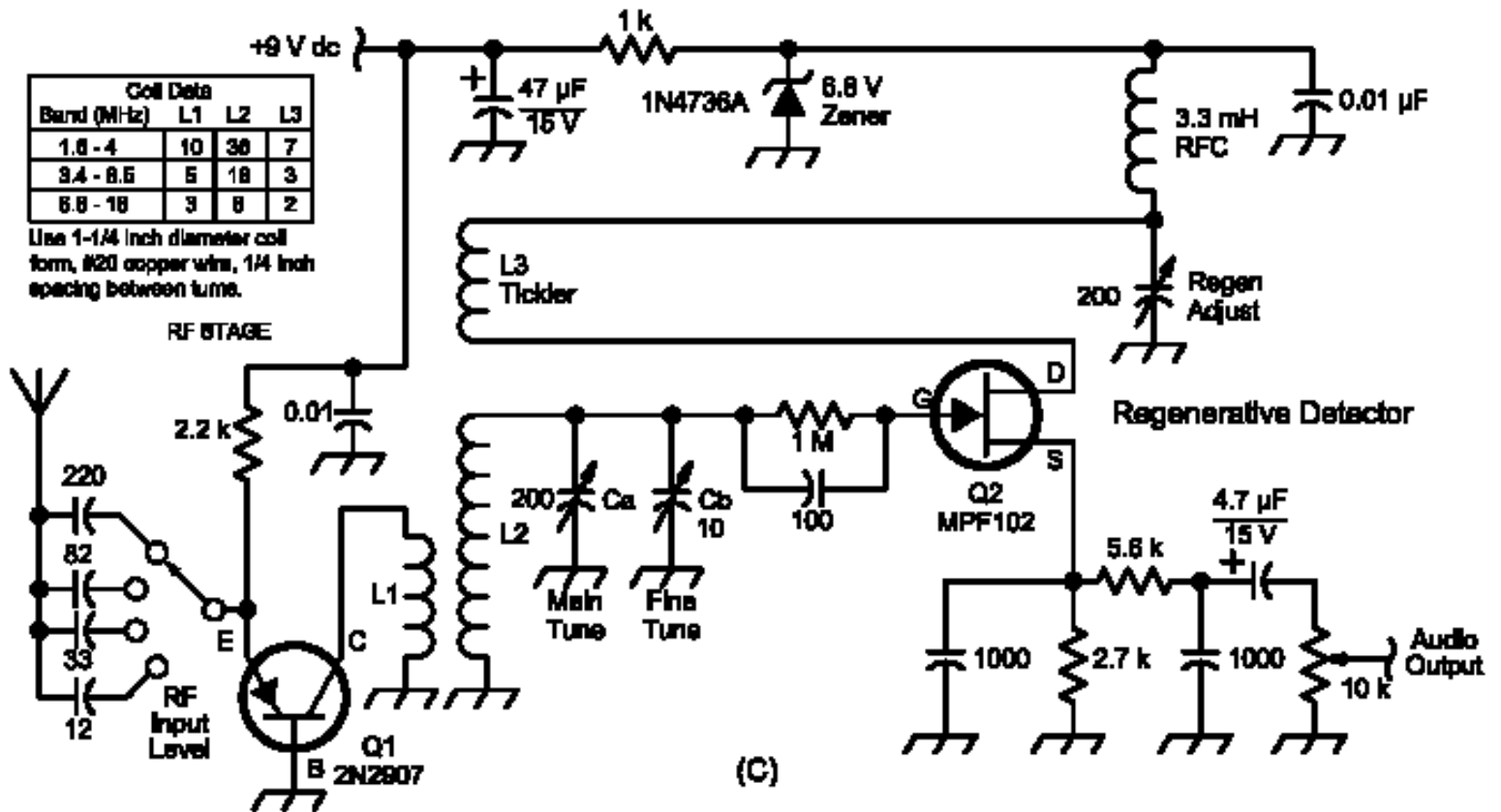


THE GROUND SYMBOLS IS THE SAME AS CONNECTING WITH A WIRE

GROUND = 0 VOLTS



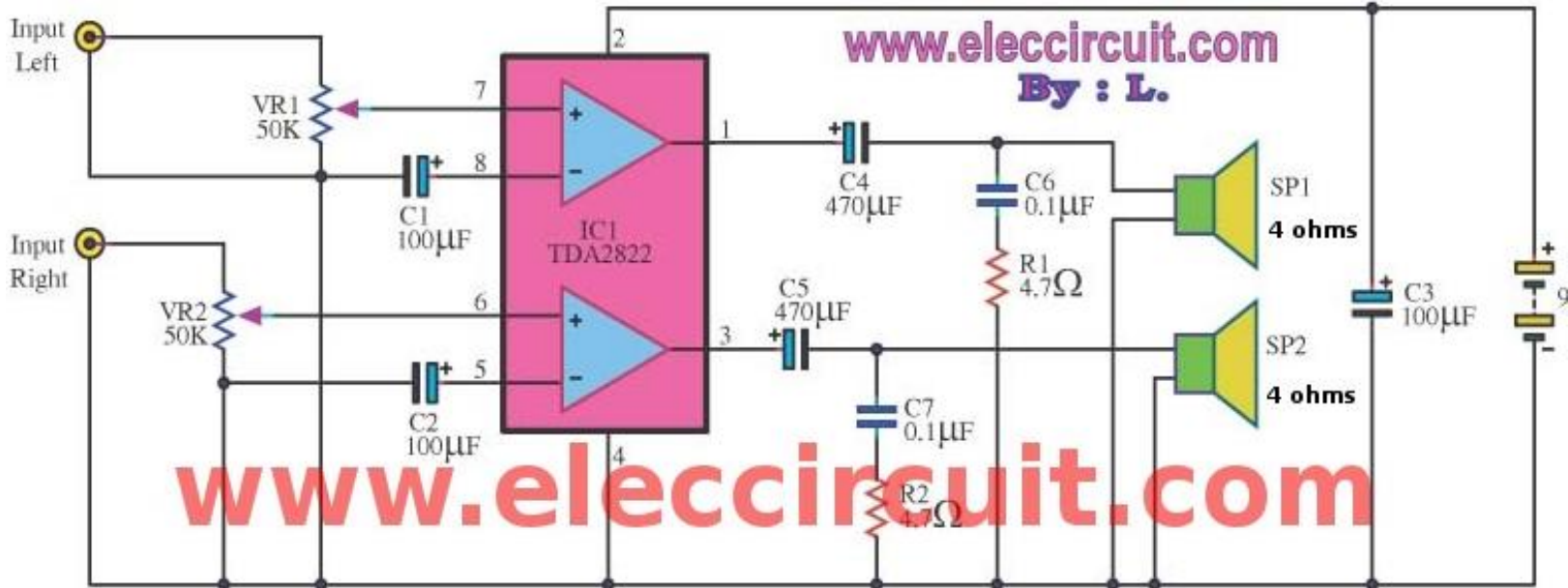
Simple Schematic diagram of a Receiver. *Identify components.*



Requirement 2A

A PRACTICAL CIRCUIT DIAGRAM (SCHEMATIC)

Simple Audio Amplifier with Operational Amplifier (Op Amp) chip

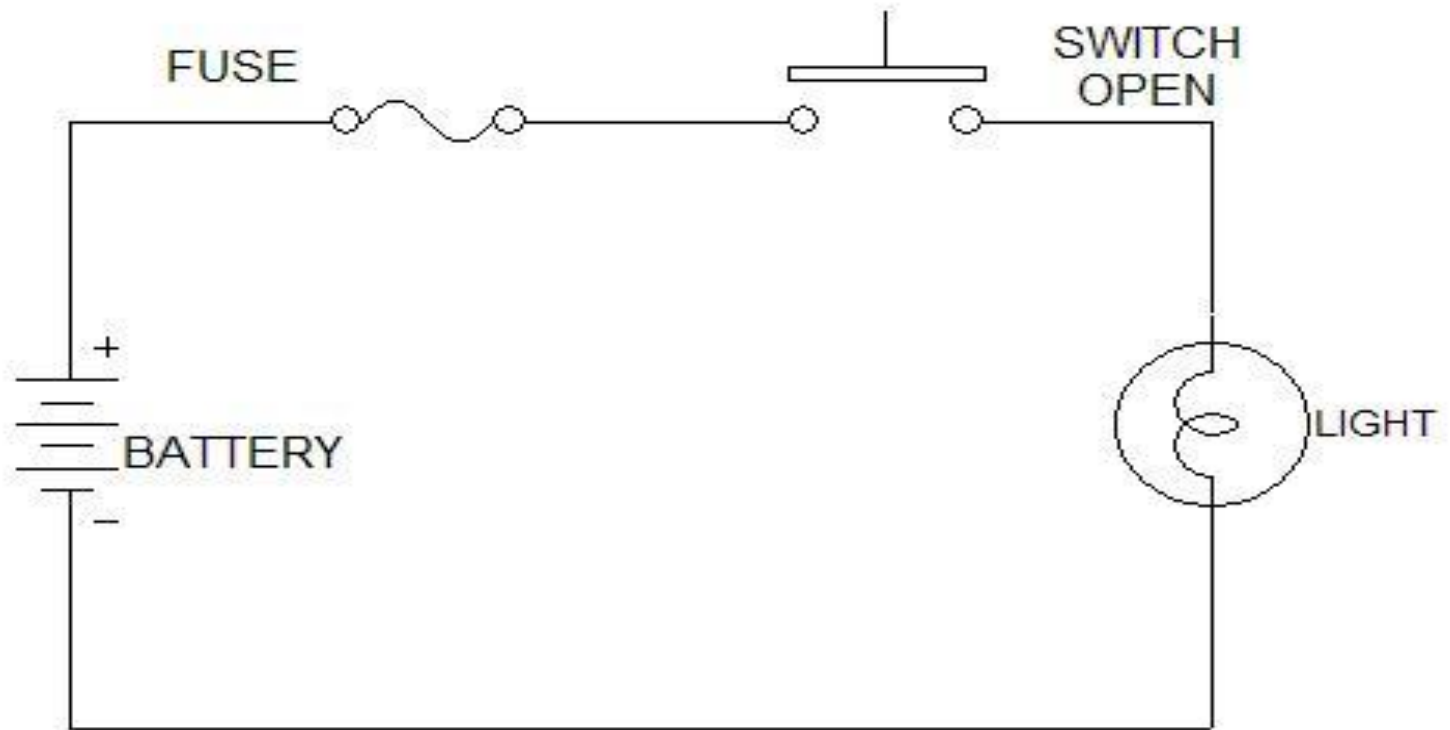


Multiple components such as transistors can be built into a single chip of silicon. In this case, several of these “Building blocks” of components are used together with a few external parts, to build a simple stereo amplifier circuit.



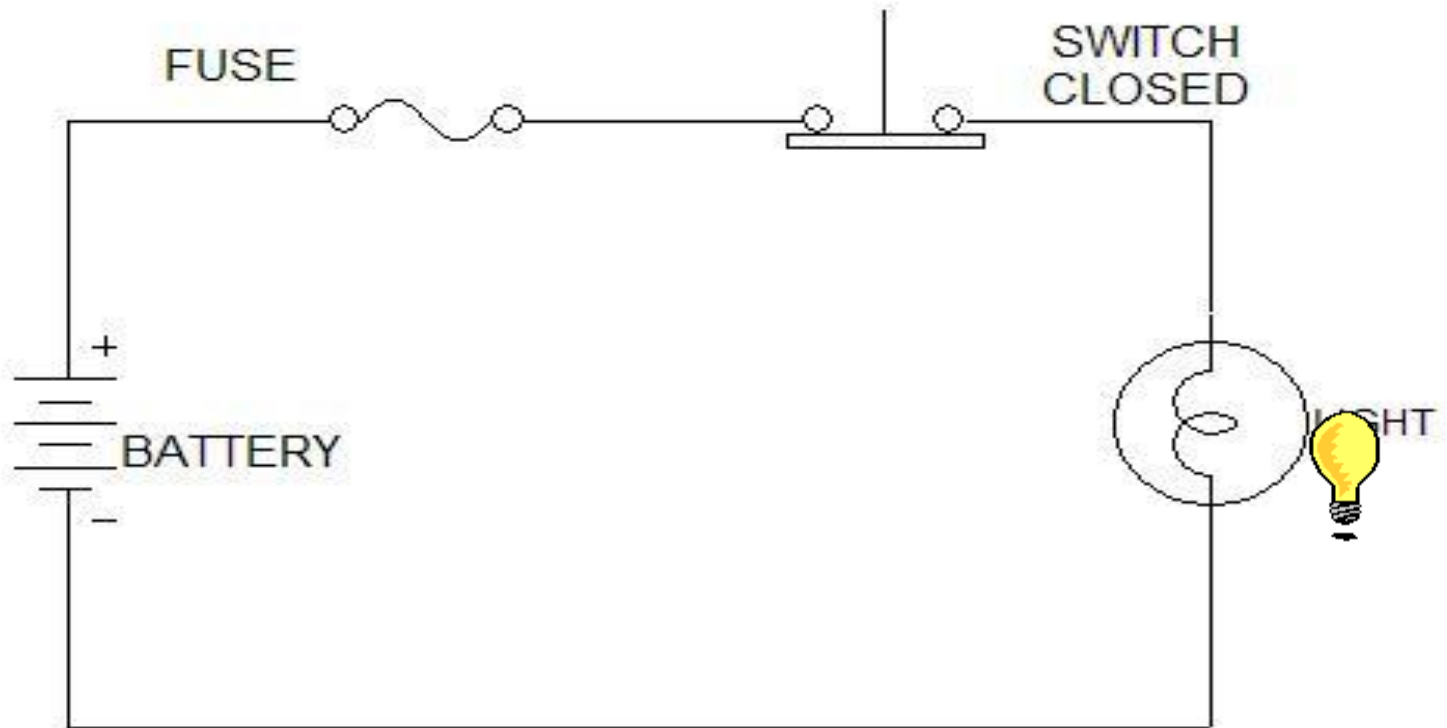
Open Circuit

- No path is available to allow current to flow from out to in of a power source.



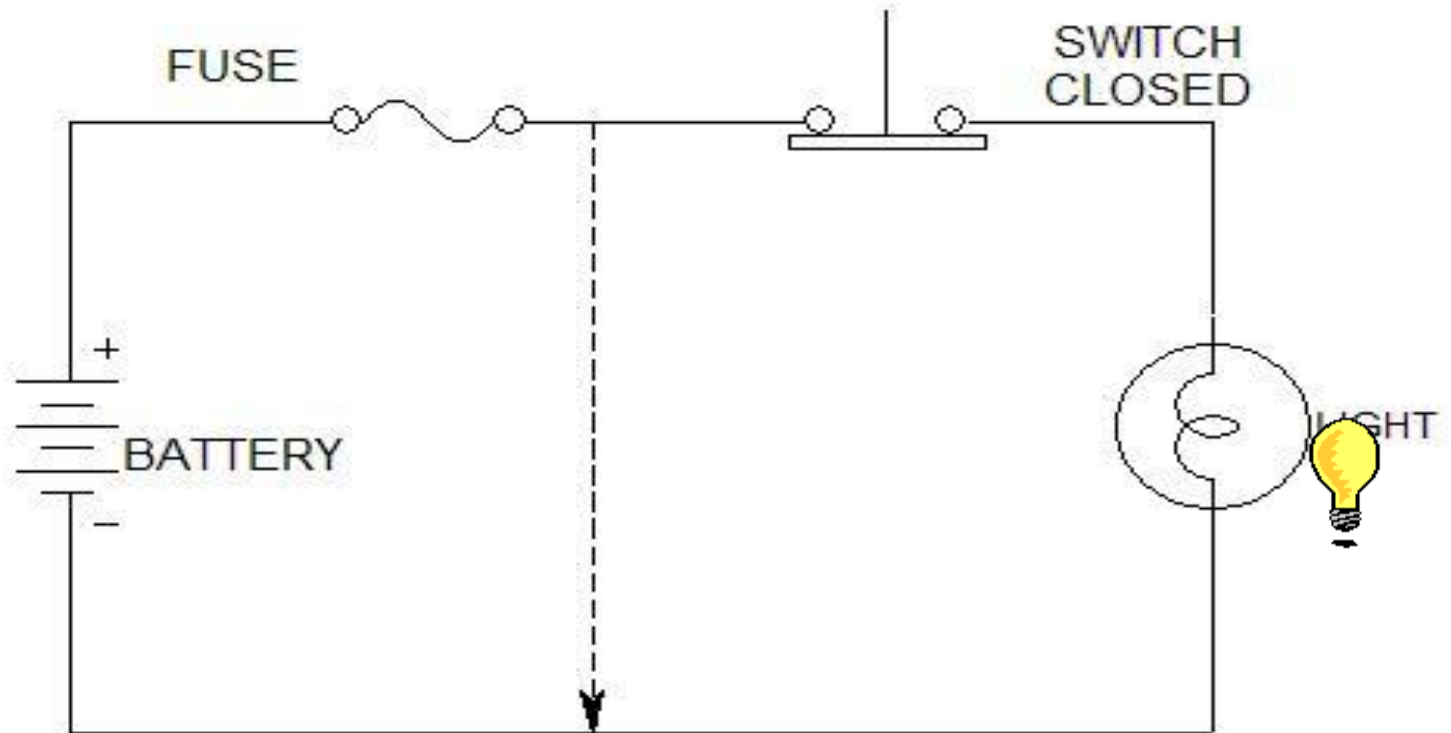
Closed Circuit

- Path for current flow available to do meaningful work.



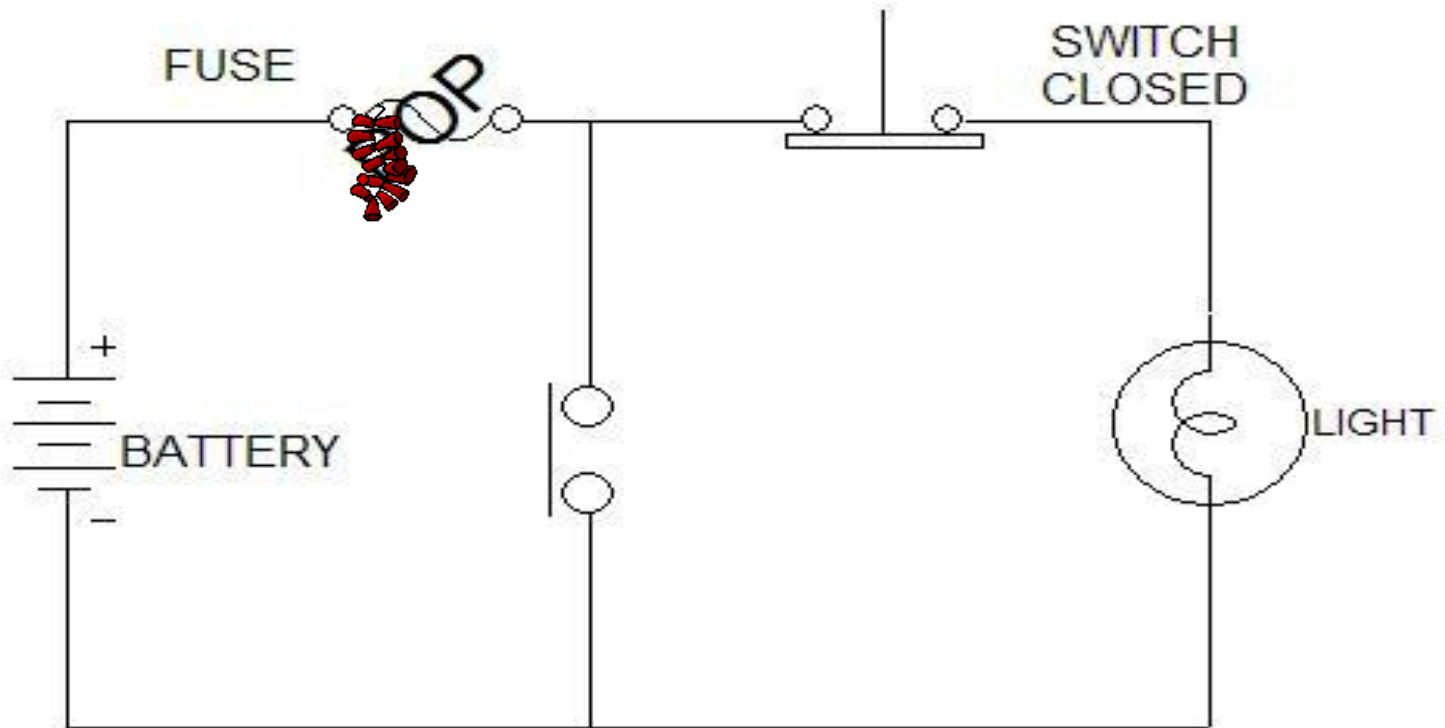
Short Circuit

- A path of no resistance for current to flow.



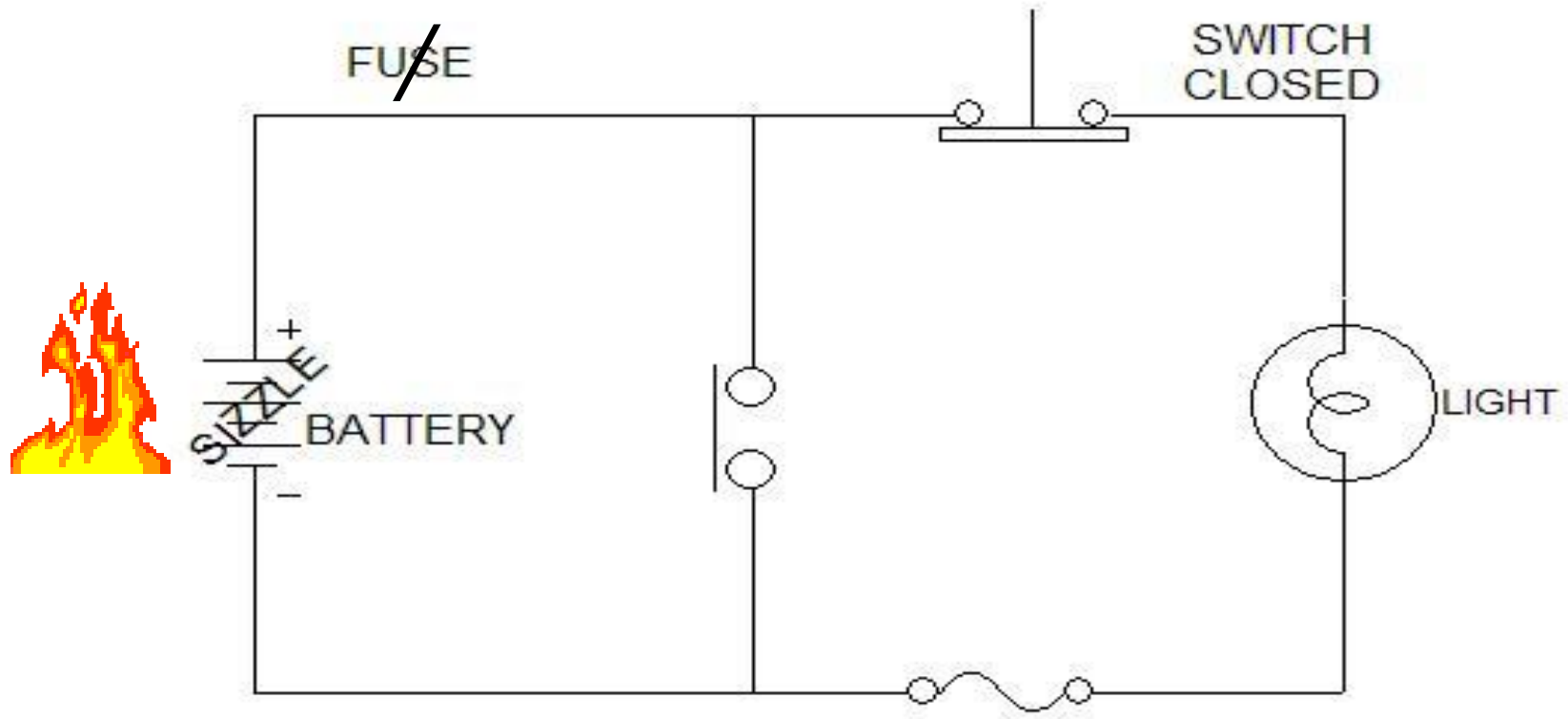
Short Circuit

- An unimpeded path for current to flow.



Short Circuit

- Fuses or breakers should be placed as close to the power source as possible.

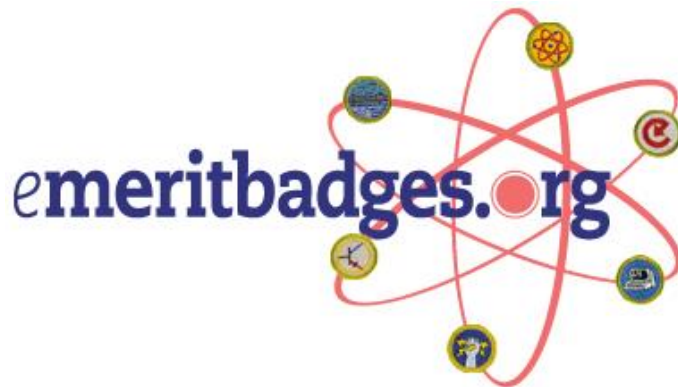




Electronics Merit Badge

Electronic components

Requirement 2B



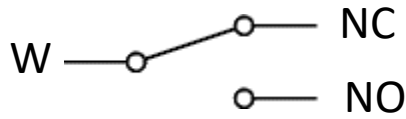


Requirement 2B

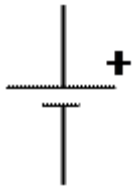
Name some of the different types of electronic components and how they might be used in a circuit.



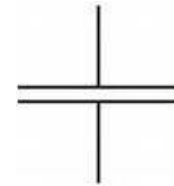
Electronic Symbols



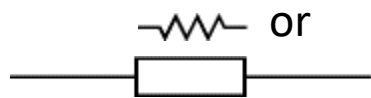
Single Pole, Double Throw Switch (SPDT)



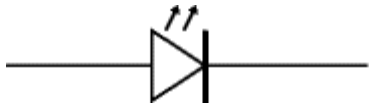
Battery



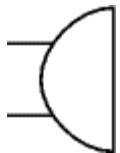
Capacitor



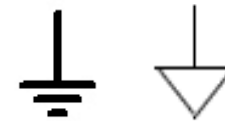
Resistor



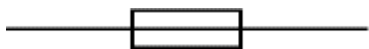
Light Emitting Diode (LED)



Buzzer



Ground



Fuse

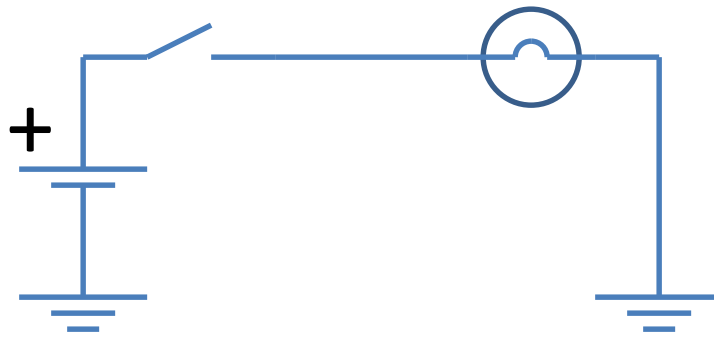


Lamp



CIRCUIT DIAGRAM (SCHEMATIC)

FLASHLIGHT



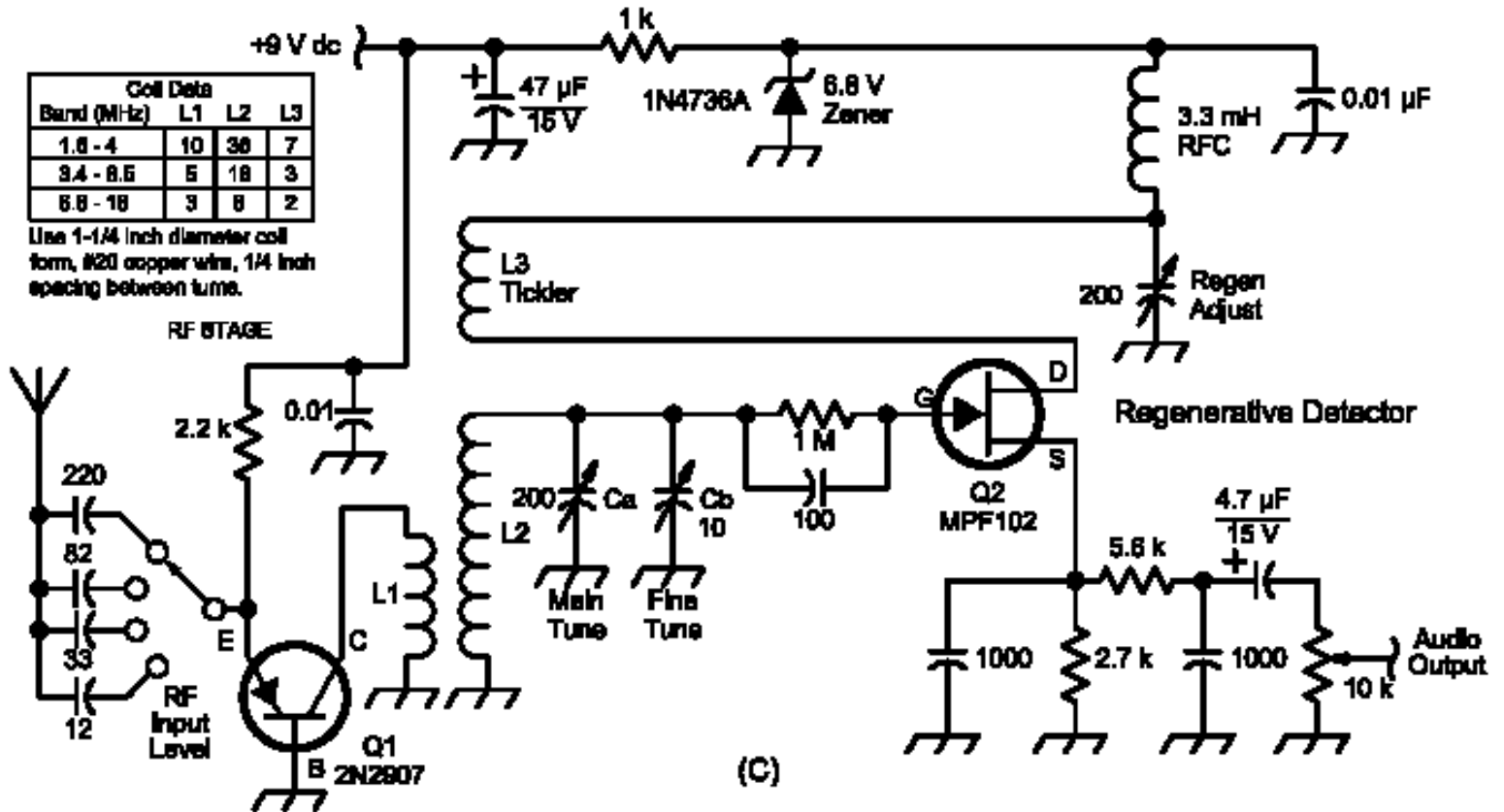
Name the components

GROUND = 0 VOLTS



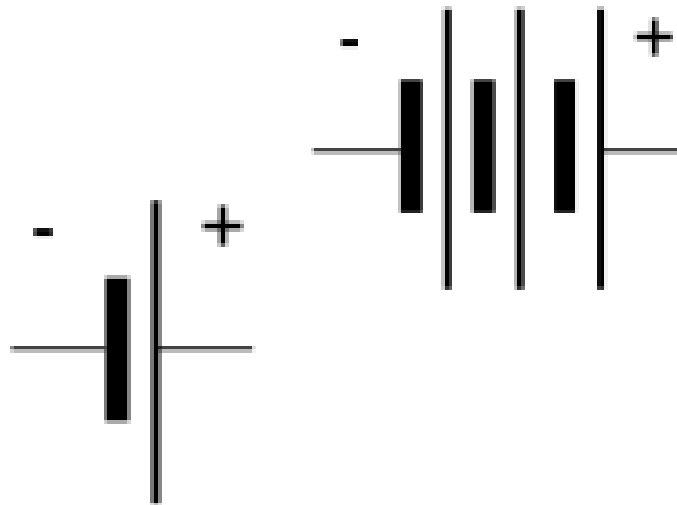
Simple Schematic diagram of a Radio Receiver.

Name the components



Schematic symbols and the jobs the parts do.

- Batteries produce a Direct Current and voltage by means of chemical reaction

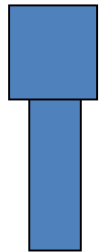


http://en.wikipedia.org/wiki/Electronic_symbol



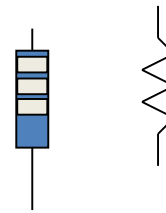
Electronic Components: Resistors

Pipe



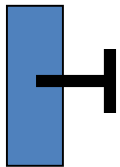
1" Pipe
1/2" Pipe
Smaller pipe restricts flow of fluids

Resistor

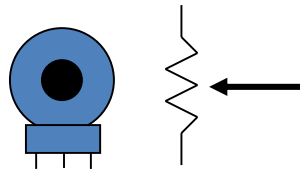


Resistor restricts flow of current.
Resistors are made of carbon or wire.

Valve



Valve restricts flow of fluids



Variable Resistor is a Potentiometer

This could be used to control volume in a radio

Resistance measured in Ohms (Symbol = Ω)

2" pipe
1" pipe
3/4" pipe
1/2" pipe
1/4" pipe

The smaller the pipe the more restriction of flow

The larger the resistor value the more restriction to current flow

1 ohm
10 ohm
100 ohm
1,000 ohm = 1 K ohm
10,000 ohm = 10 K ohm
100,000 ohm = 100 K ohm
1,000,000 ohm = 1 M ohm

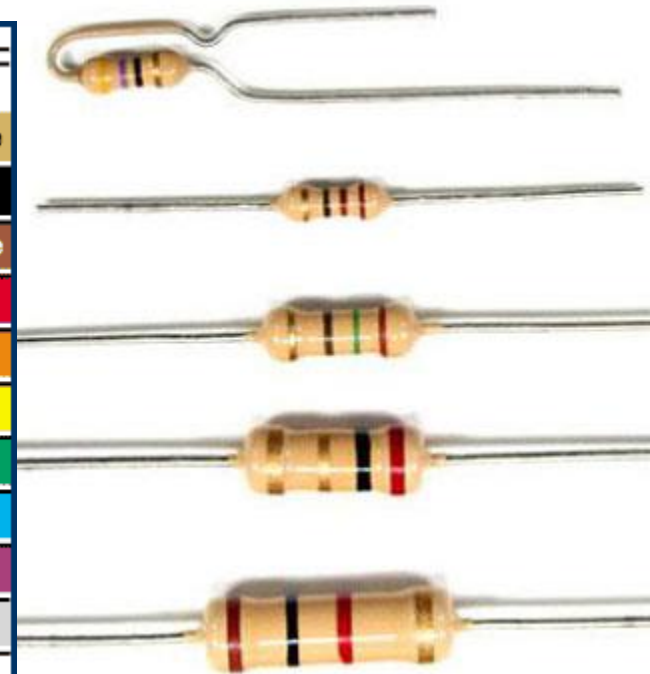


Schematic symbols and the jobs the parts do.

- A Resister causes a limitation on the amount of current that can flow.



	1st Digit	2nd Digit	Multipplier	Tolerance
Gold	-	-	±10	5% tolerance
Black	0			
Brown	1	1	0	1% tolerance
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	0000000	
Grey	8	8		
White	9	9		

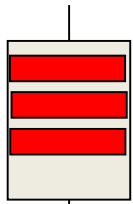


http://en.wikipedia.org/wiki/Electronic_symbol



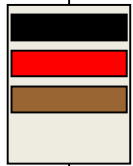
Resistor Value Examples

<u>Ring</u>	
Black	= 0
Brown	= 1
Red	= 2
Orange	= 3
Yellow	= 4
Green	= 5
Blue	= 6
Violet	= 7
Gray	= 8
White	= 9



First Ring is **TENS**
 Second Ring is **ONES**
 Third Ring is **Number of Zero's**

Example of Color Rings



First Ring

Red = 2
 Black = 0

Second Ring

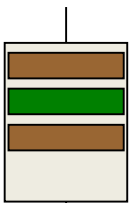
Red = 2
 Red = 2

Third Ring

Red = X 100
 Brown = X 10

= 2200 ohms
 = 020 ohms

Test of Color Rings



First Ring

Brown = _____

Second Ring

Green = _____

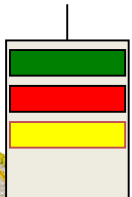
Third Ring

Brown = _____ = _____ ohms

Green = _____

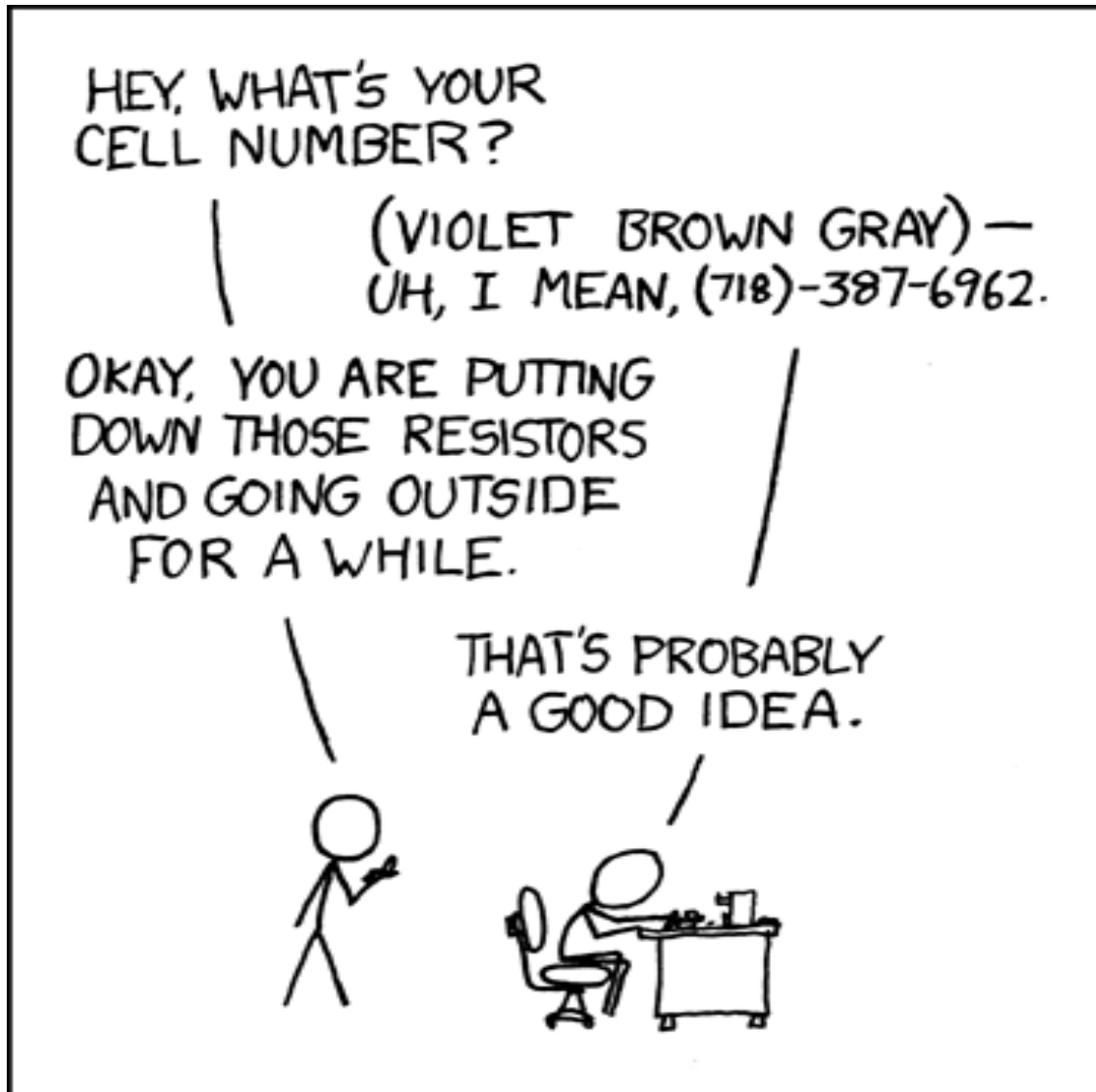
Red = _____

Yellow = _____ = _____ ohms



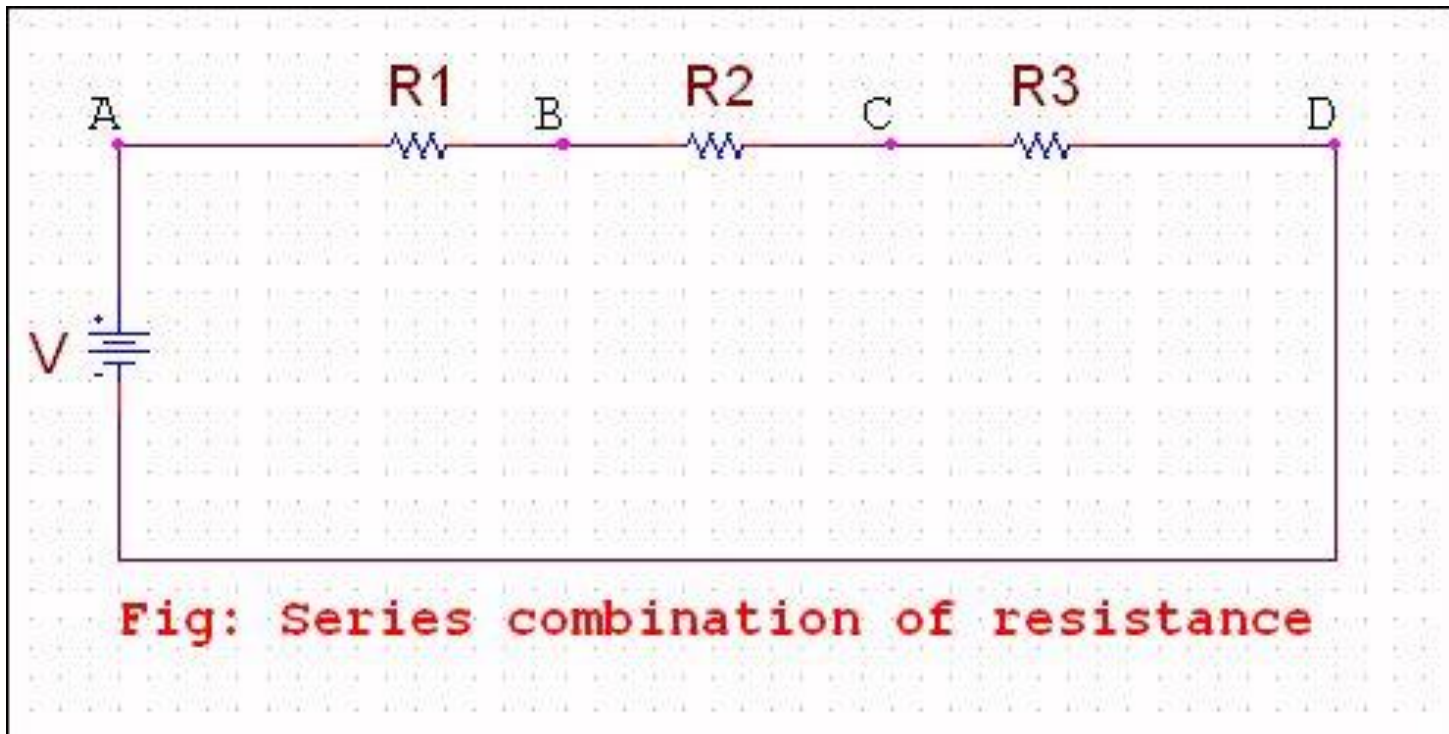
Resistor Value Examples

<u>Ring</u>	
Black	= 0
Brown	= 1
Red	= 2
Orange	= 3
Yellow	= 4
Green	= 5
Blue	= 6
Violet	= 7
Gray	= 8
White	= 9



Series and Parallel Resistance

Series resistances add together to make Total Resistance.

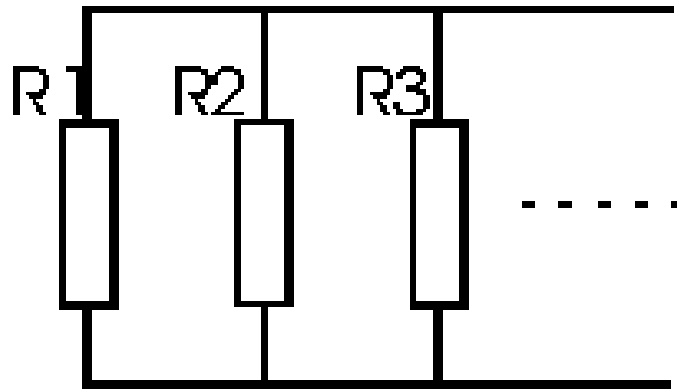


$$R_{\text{total}} = R_1 + R_2 + R_3 \dots$$



Series and Parallel Resistance

Parallel resistances divide by the totals.



$$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$











If only two resistors are in parallel, then...

$$R_{\text{total}} = \frac{R_1 \times R_2}{R_1 + R_2}$$



Schematic symbols and the jobs the parts do.

- A Variable Resistor (Potentiometer) allows selection of it's resistance value.

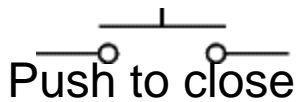
TYPICAL RESISTOR	TYPE	SYMBOL
A 	FIXED CARBON	
B 	FIXED WIREWOUND (TAPPED)	
C 	ADJUSTABLE WIREWOUND	
D 	POTENTIOMETER	
E 	RHEOSTAT	

www.tpub.com/neets/book1/chapter1/1p.htm

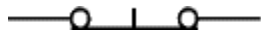


Schematic symbols and the jobs the parts do.

- Switches allow the ability to open or close a circuit to the flow of current.



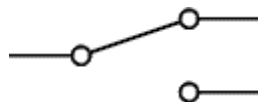
Push to close



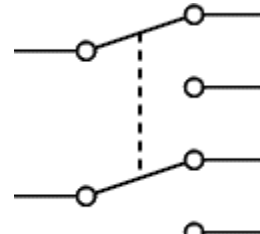
Push to open



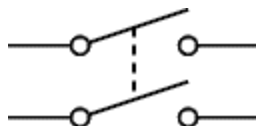
SPST



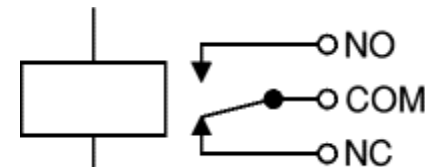
SPDT



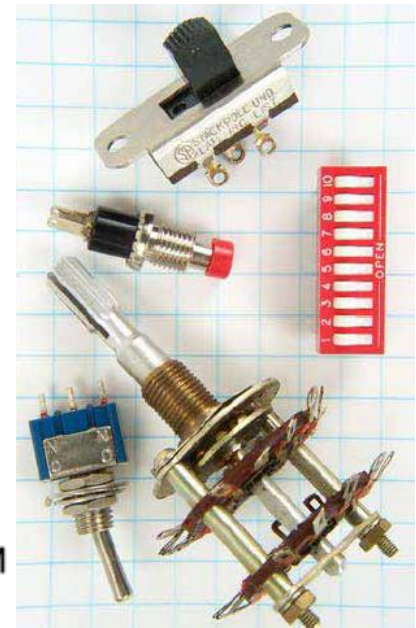
DPDT



DPST



Electrically operated switch



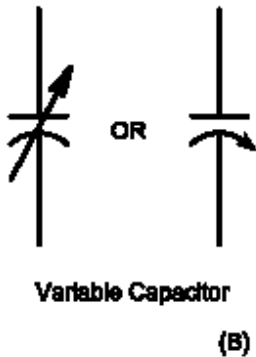
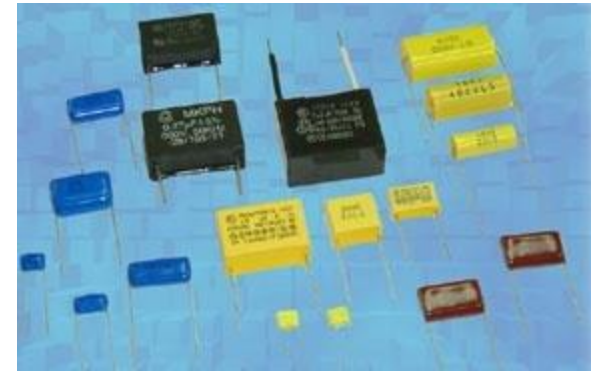
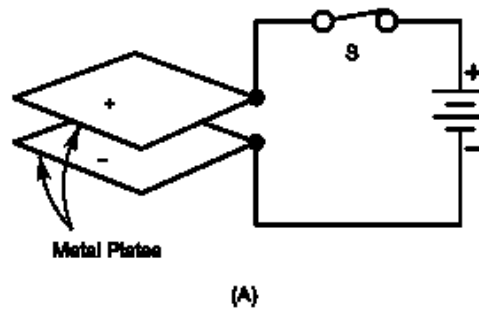
ARRL Amateur Radio Handbook, ©2005



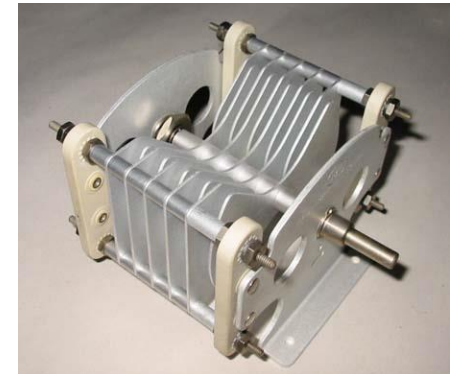
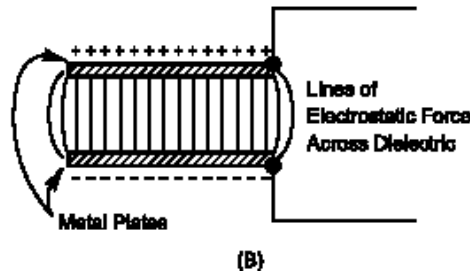
Schematic symbols and the jobs the parts do.

- Capacitors store electrical energy in an electrostatic field between metal plates.

hbk05_04-026

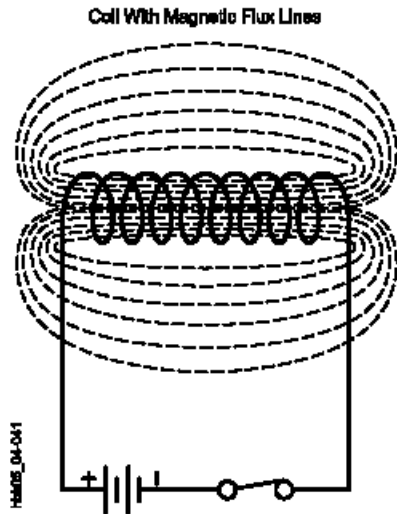


hbk05_04-025

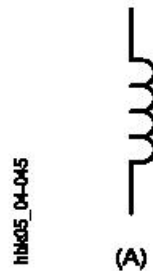


Schematic symbols and the jobs the parts do.

- Inductors are coils of wire that store electrical energy in a magnetic field.



Air Core



Variable

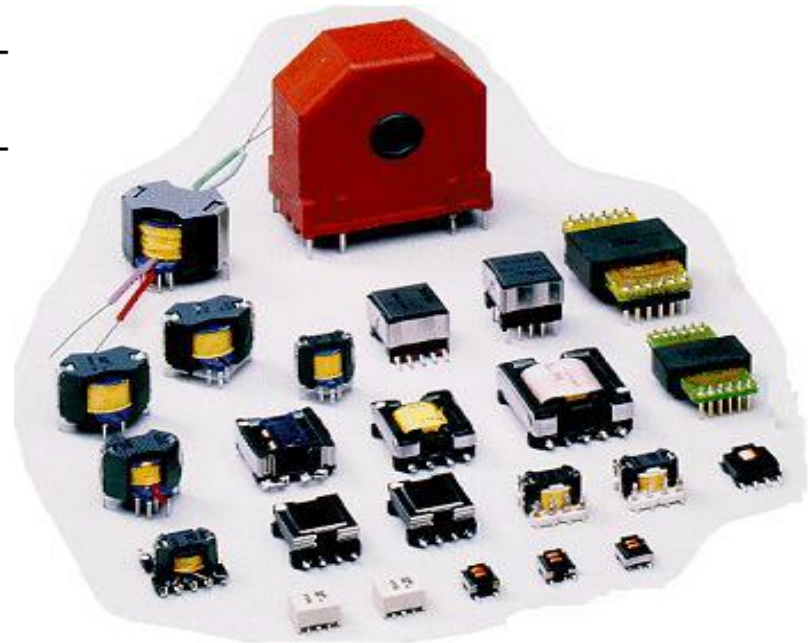
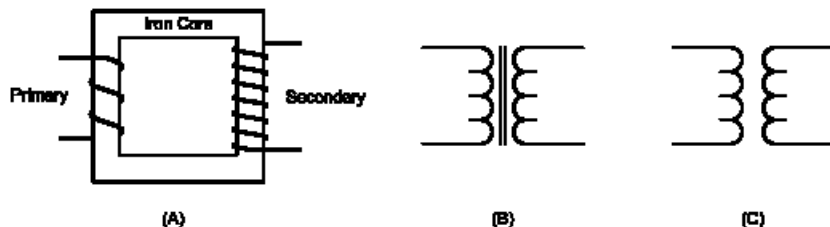


Magnetic or Iron Core



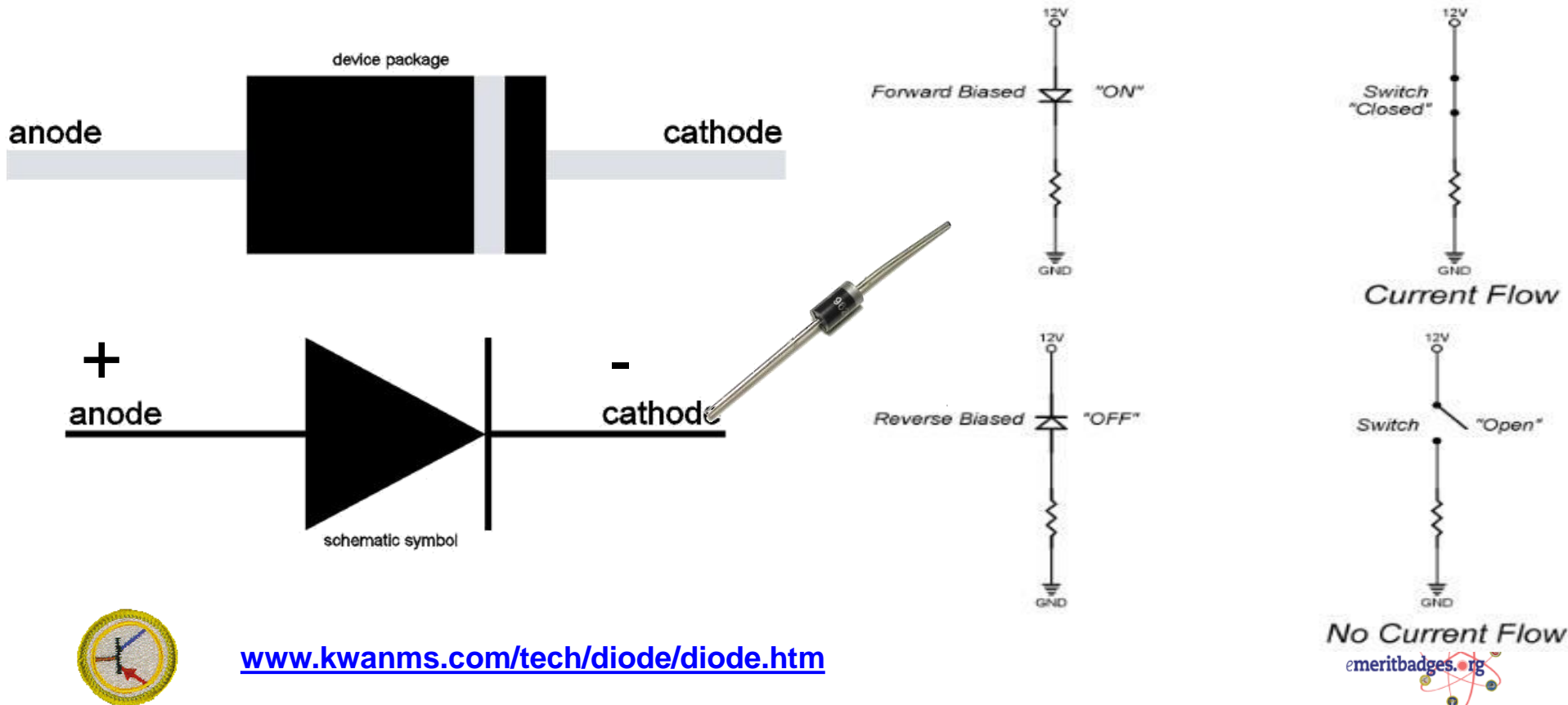
Schematic symbols and the jobs the parts do.

- Transformers are two inductors positioned so they transfer energy from one coil to another.



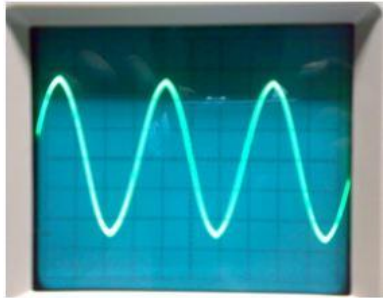
Schematic symbols and the jobs the parts do.

- A Diode is a semiconductor device that only allows current to flow in one direction.

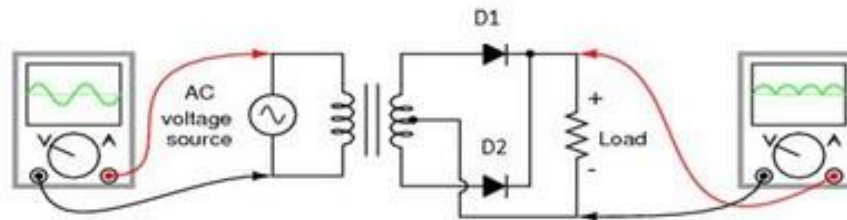
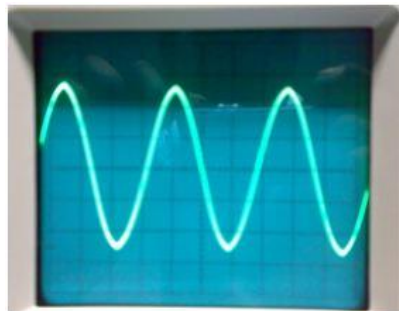
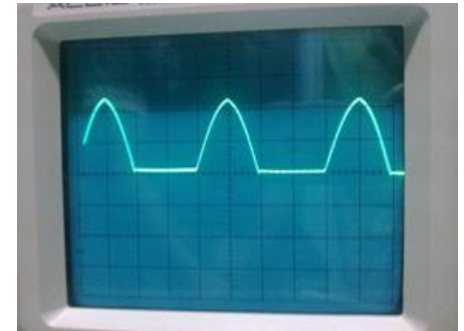


Schematic symbols and the jobs the parts do.

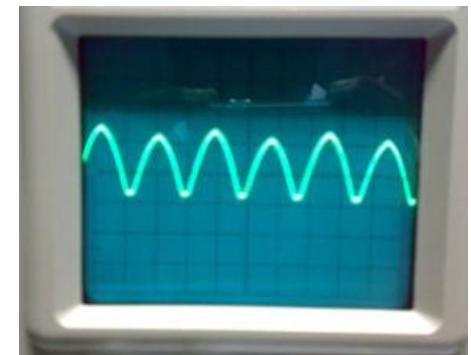
- A Device called a “Power Supply” is used to change AC line current to DC for device use.



Half Wave Rectifier

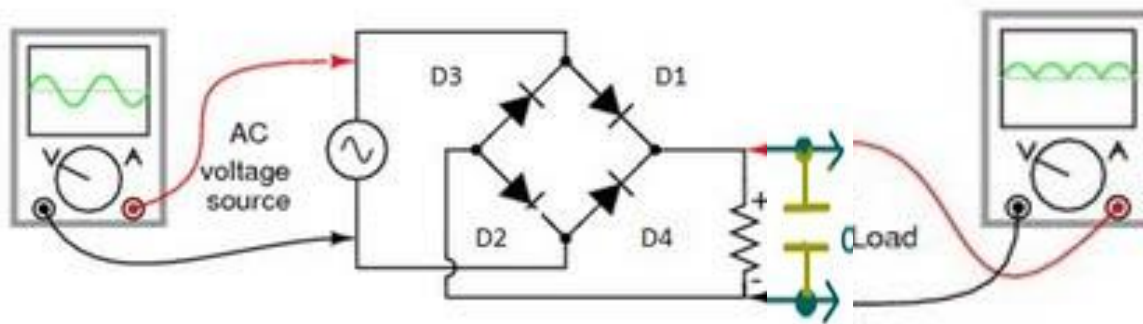
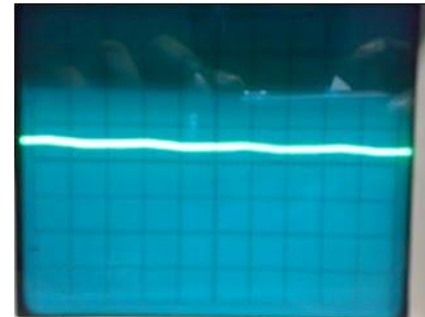
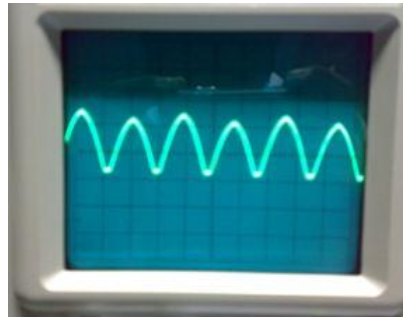
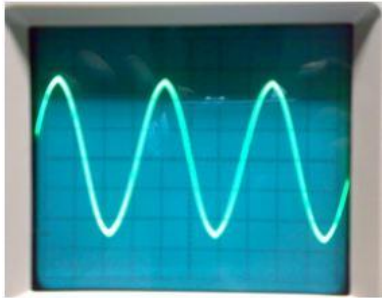


Full Wave Rectifier



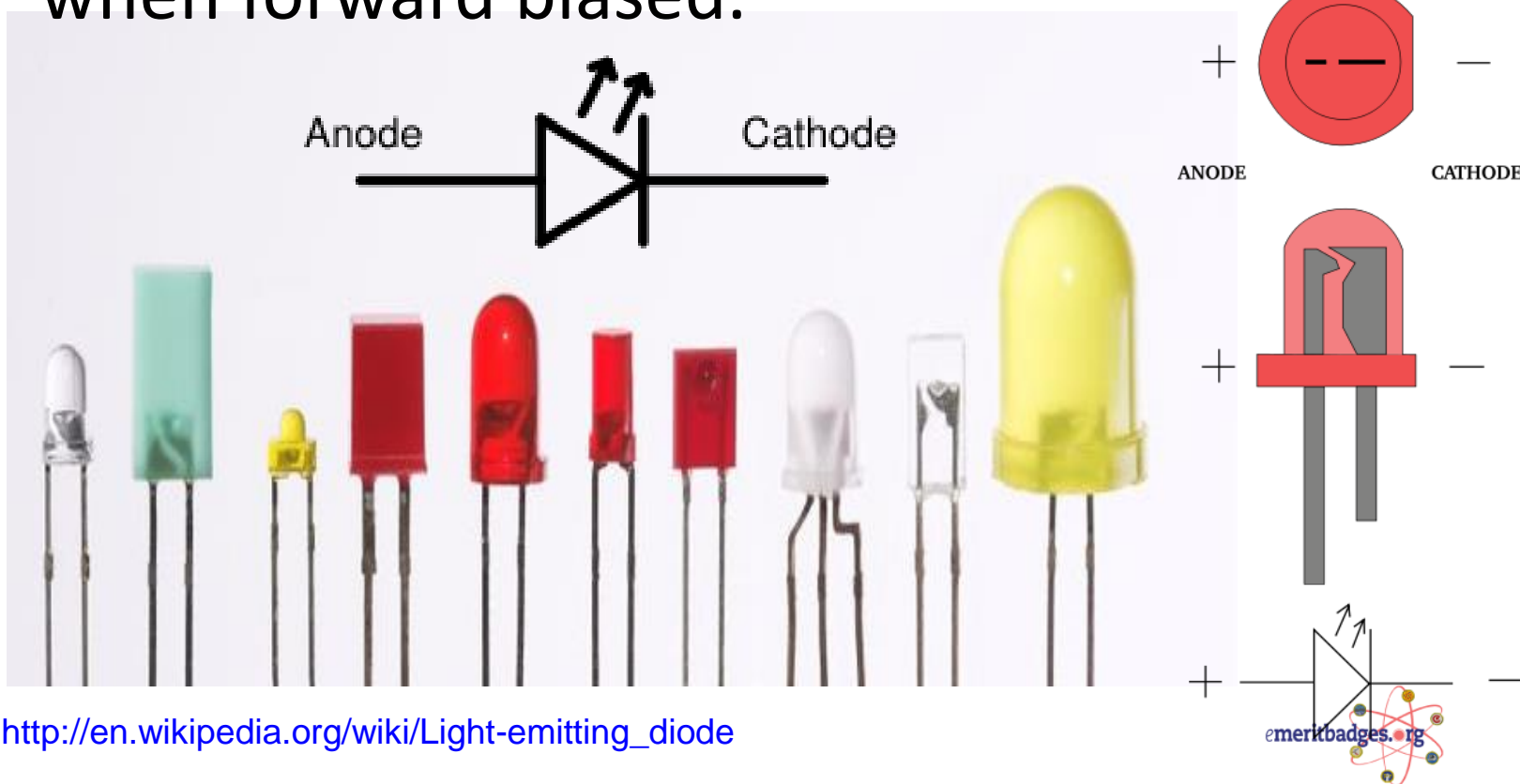
Schematic symbols and the jobs the parts do.

- Add a capacitor to filter and smooth the output and you have a DC Power Supply. (Wall Wart)



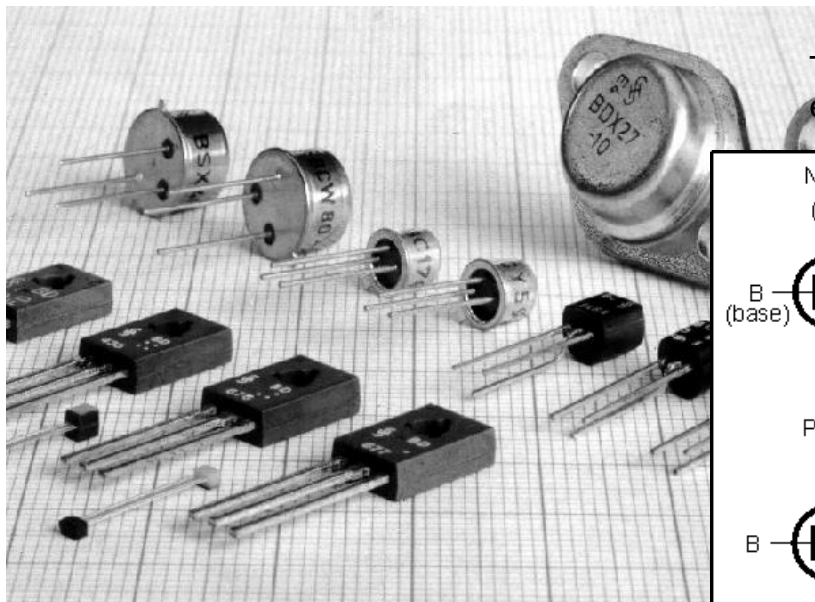
Schematic symbols and the jobs the parts do.

- A light Emitting Diode (LED) produces light when forward biased.

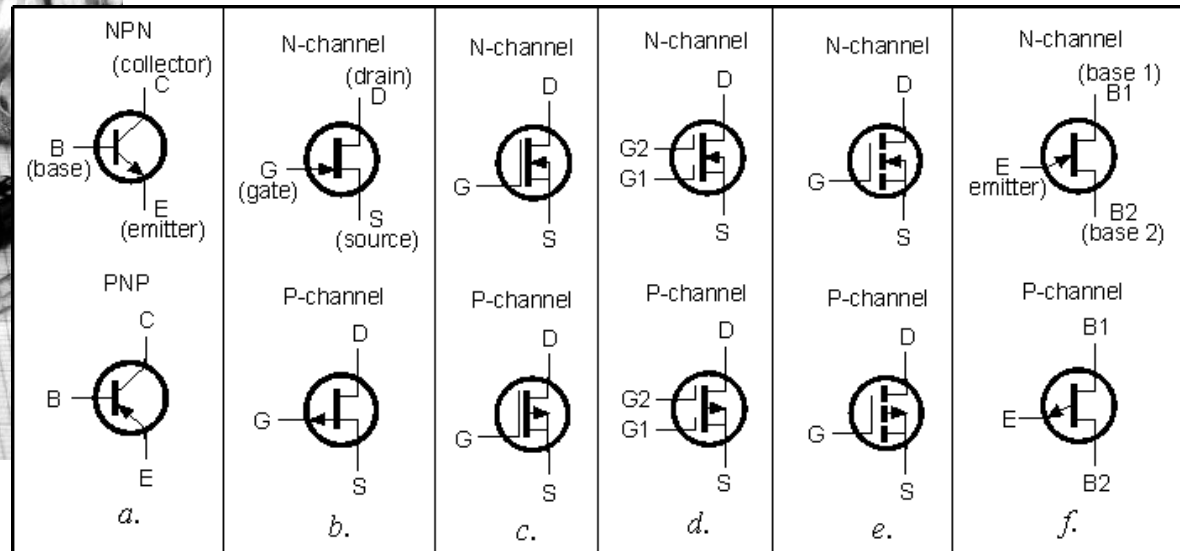


Schematic symbols and the jobs the parts do.

- Transistors are a dual junction (Or more) semiconductor that can control and amplify a signal.



Transistor symbols: a - bipolar, b - FET, c - MOSFET, d - dual gate MOSFET, e - inductive channel MOSFET, f - single connection transistor

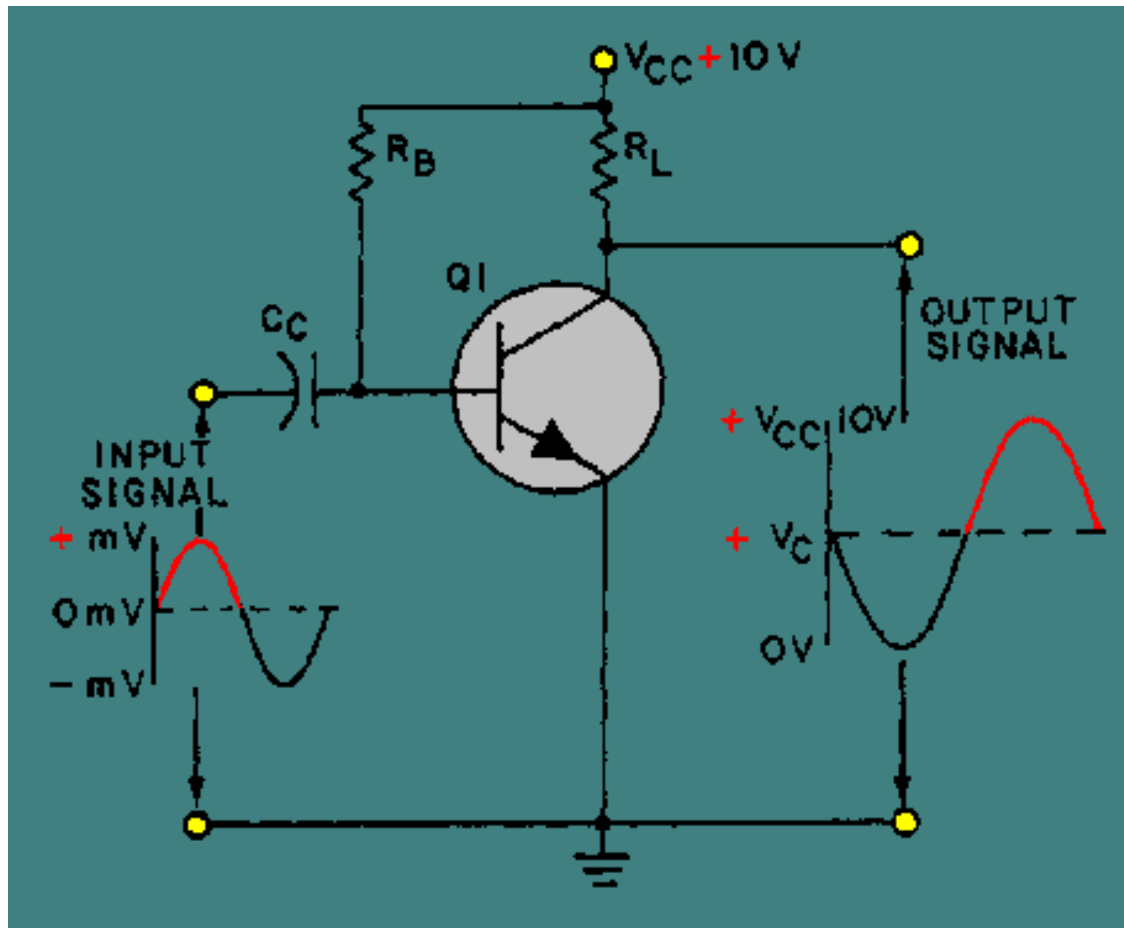


Requirement 2B

Transistors

One important use for a Transistor is as an Amplifier

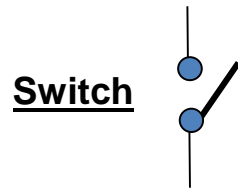
A small signal presented at the input of the circuit is translated to a larger voltage across the output.



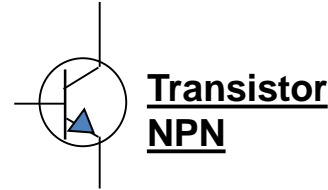
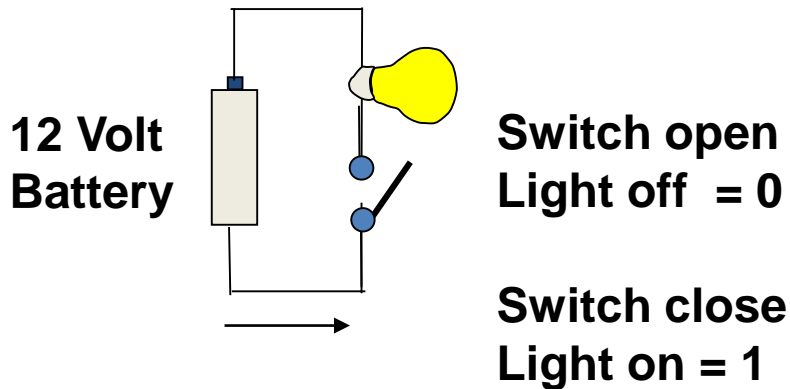
Requirement 2B

Transistors

A Transistor can be used as an Electronic Switch

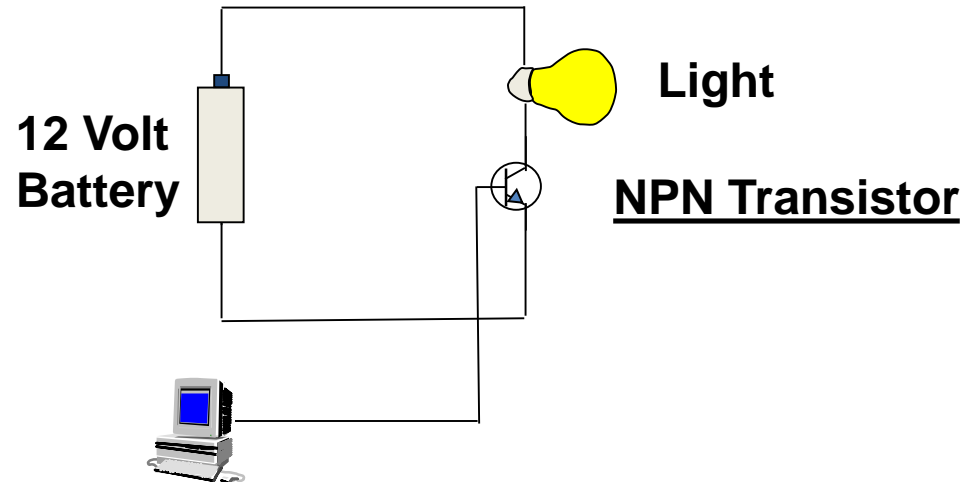


Mechanical Switch Circuit



Transistor come in different sizes depending on the amount of current and voltage required

Transistor Switch Circuit



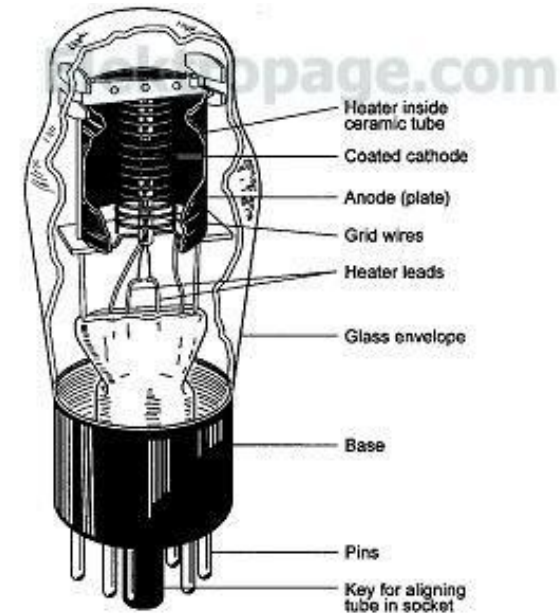
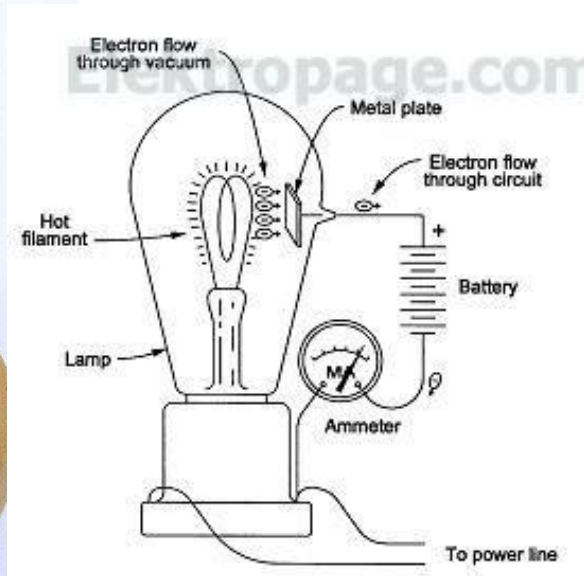
Computer can send a signal to turn on the transistor which then turns on the light



Schematic symbols and the jobs the parts do.



- **Vacuum Tubes;** Predecessor to transistors and semiconductors.
- Still used in some high power RF amplifiers and by hard core audiophiles.

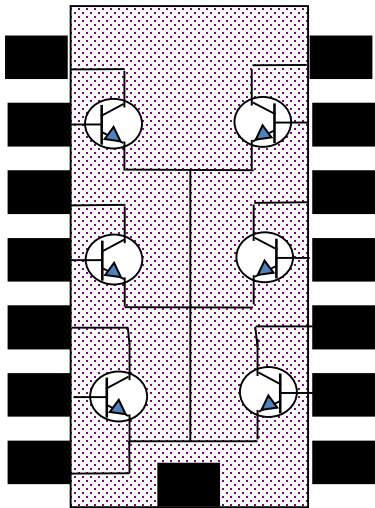


Requirement 2B

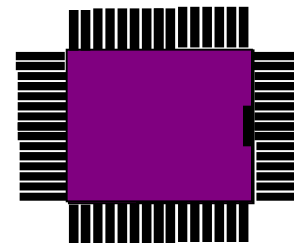
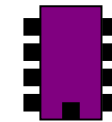
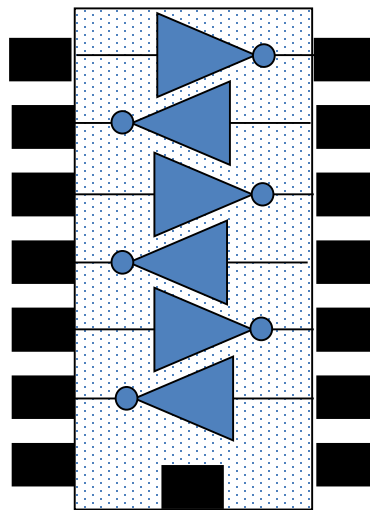
Integrated Circuits

An integrated circuit (IC) consists of multiple transistors. The number of transistors can vary from just a few (circuits shown below), to 3 or more Billion that are in a modern multi core microprocessor.

6 Transistors in one IC



This IC has 6 inverters
An inverter contains
6 Transistors = 36 total

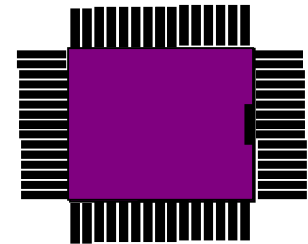
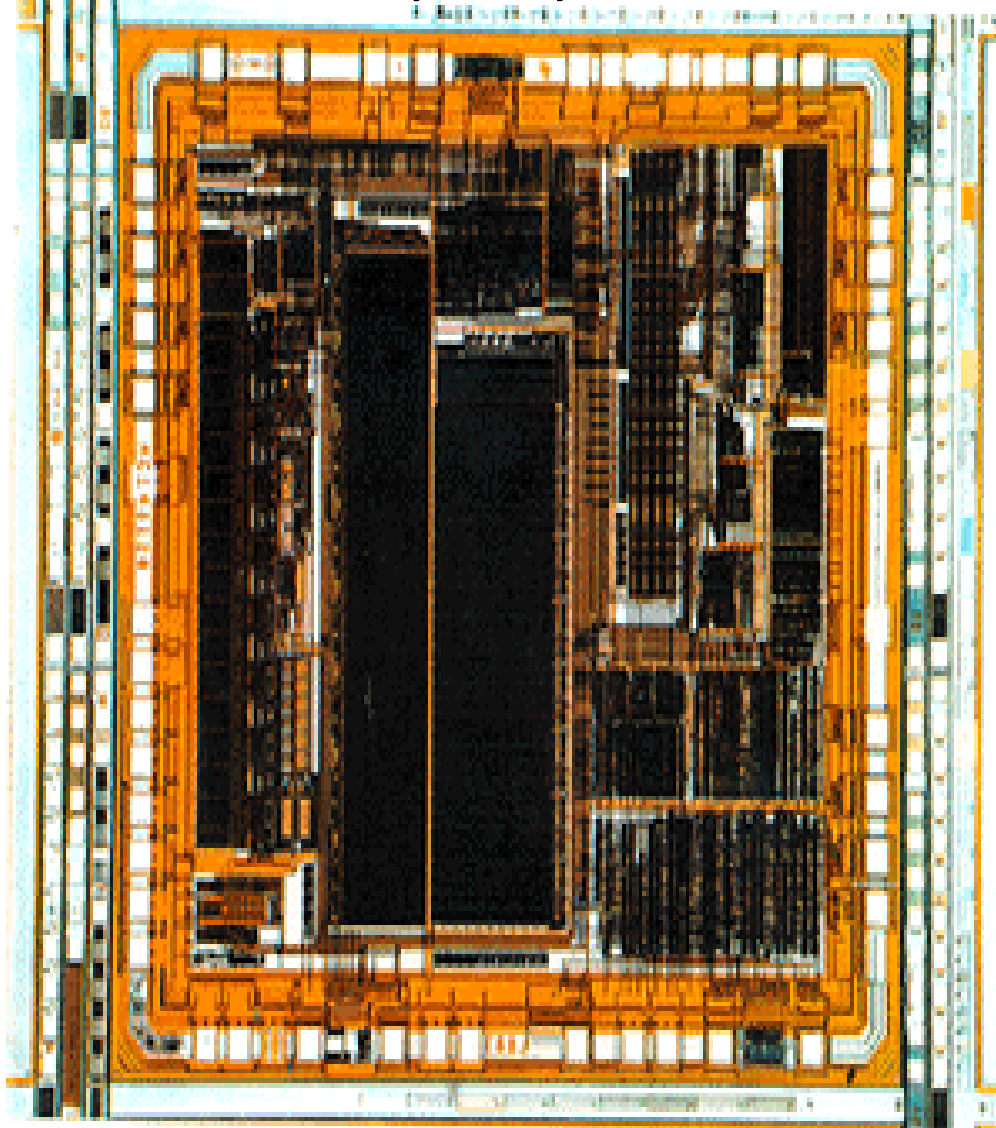


Functions

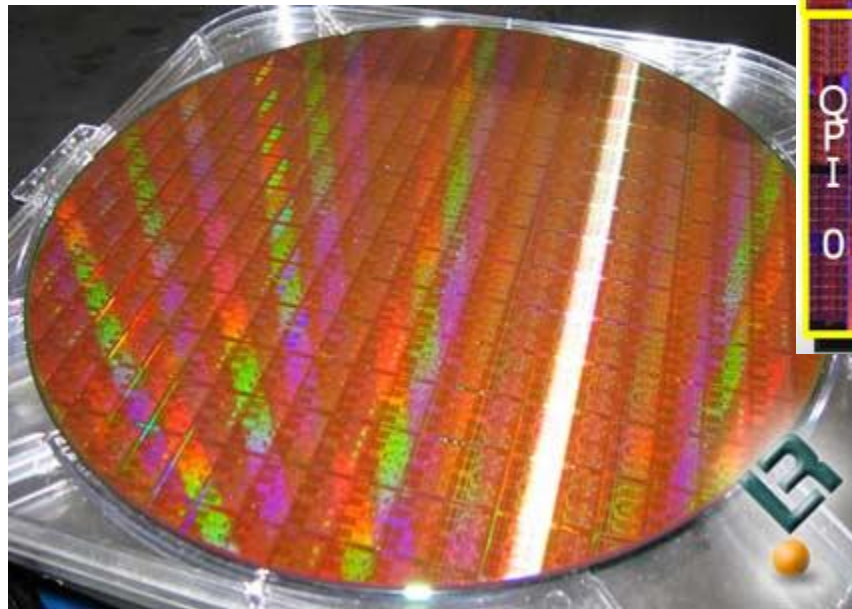
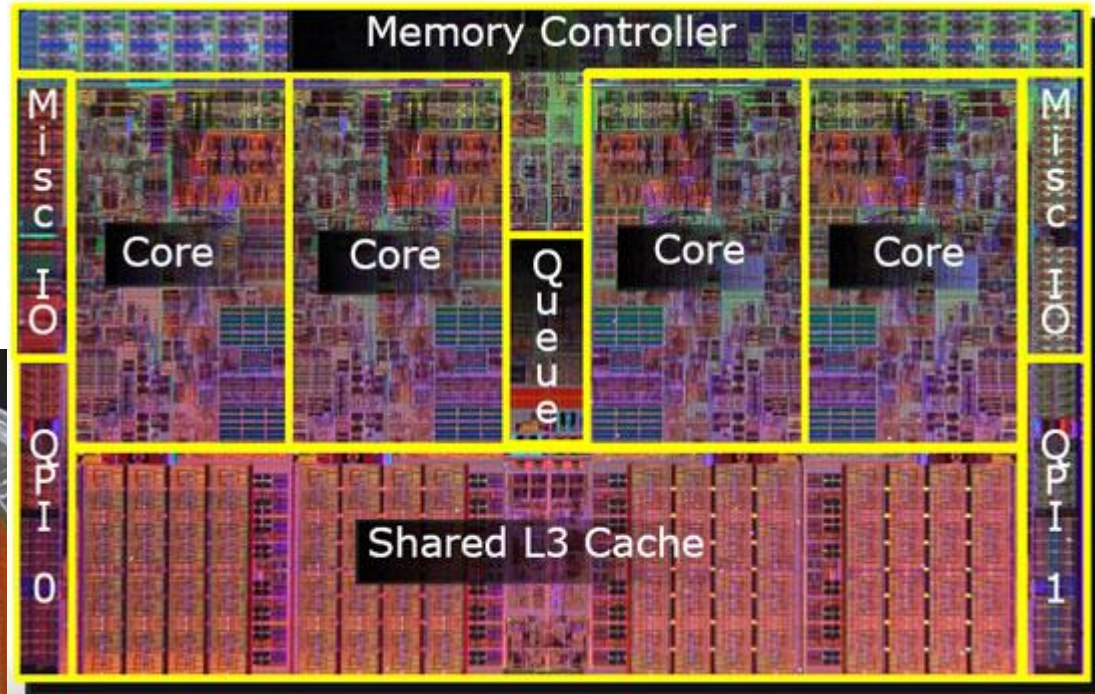
- Inverters
- Gates
- Flip flops
- Counters
- Memory
- MPU
- Watch ICs
- Calculators ICs
- Microwave Timer ICs
- Radio ICs
- Dialer ICs
- Car Controller ICs



Microprocessor Integrated Circuit: Late 1970s, 60,000 Transistors



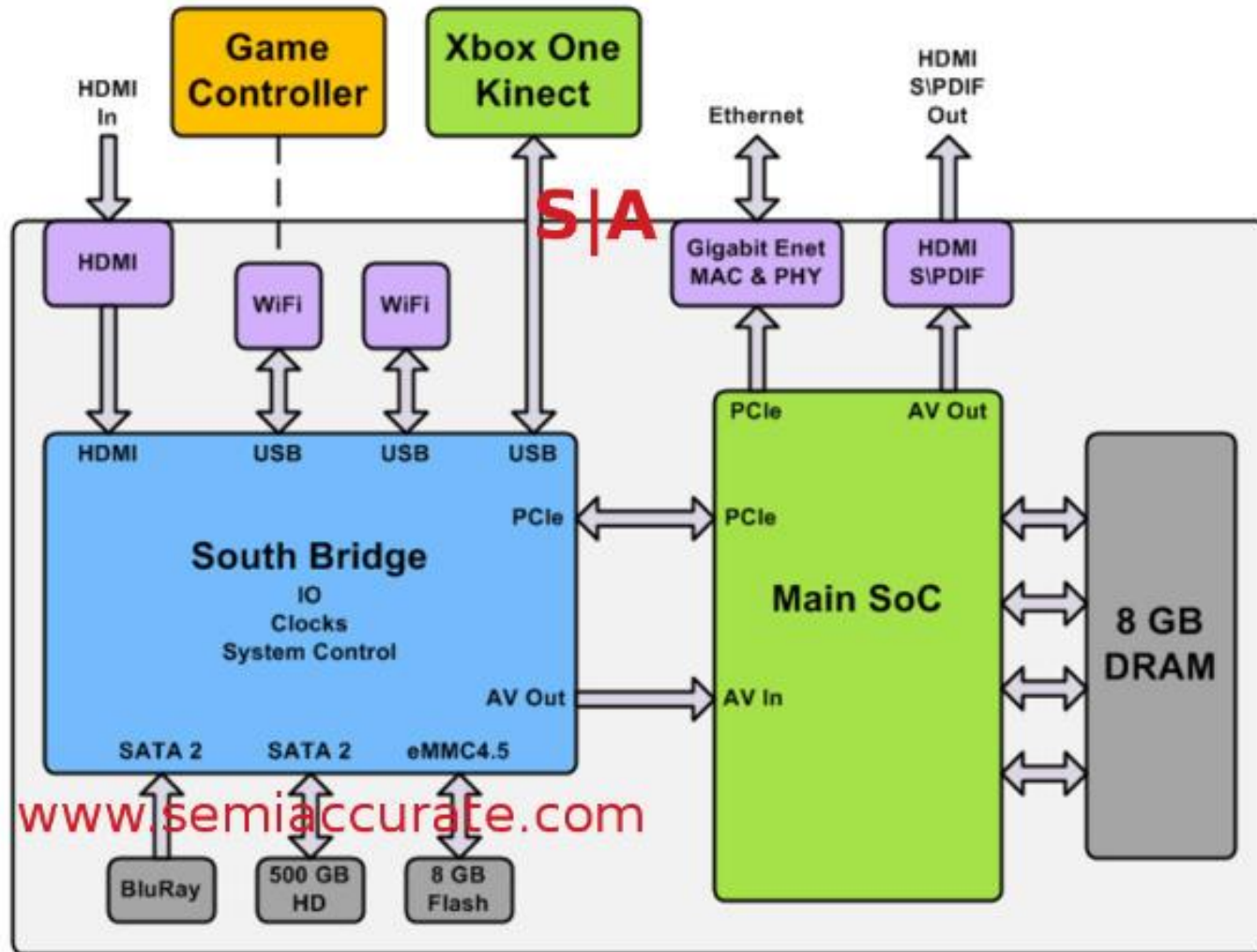
Modern processors like this Intel i7 Quad Core, have over a Billion



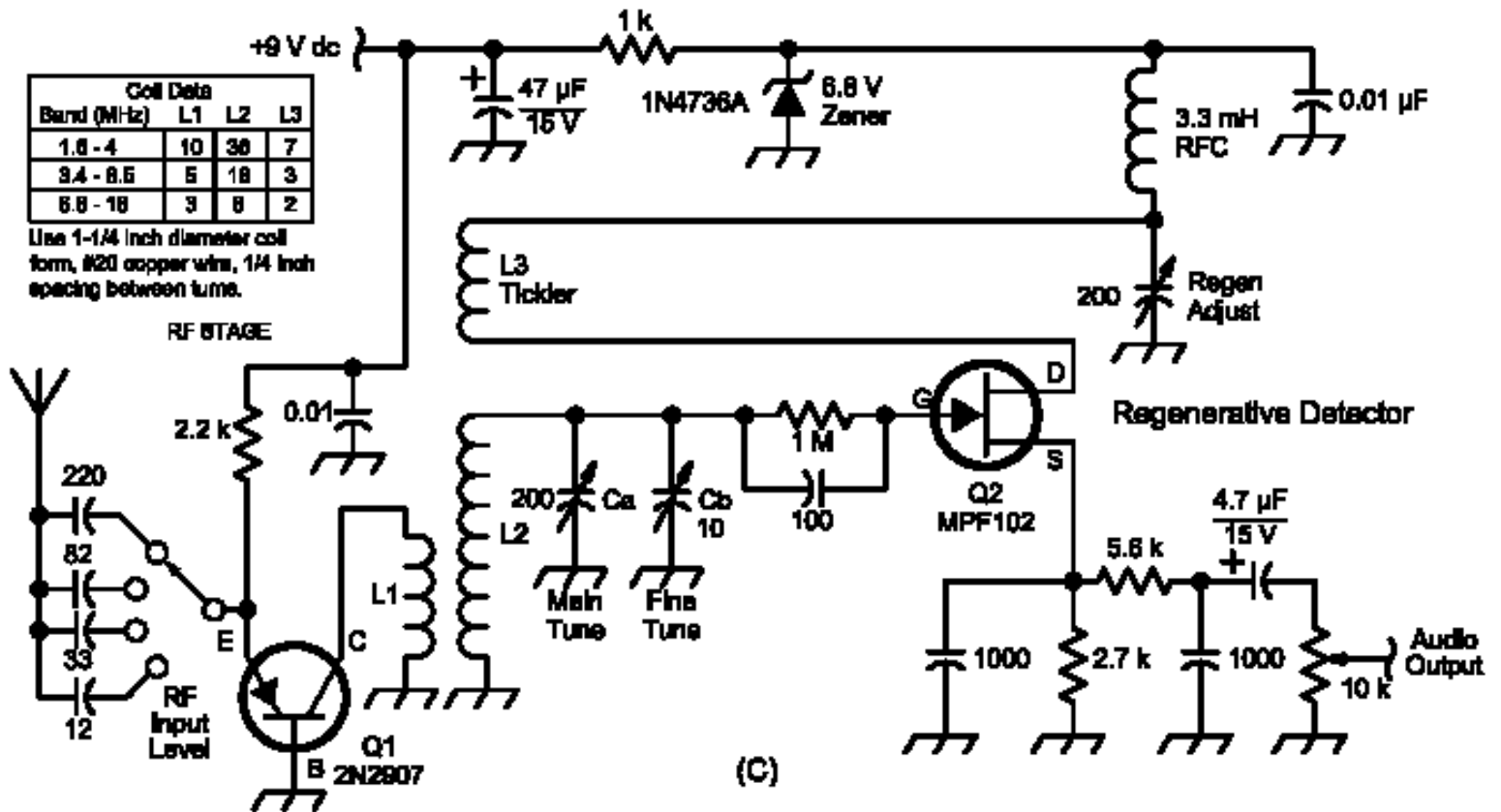
A “Lithography” or photo etching process is used to print the components onto a silicon wafer.



The Xbox One main processor has over 5 Billion Transistors.



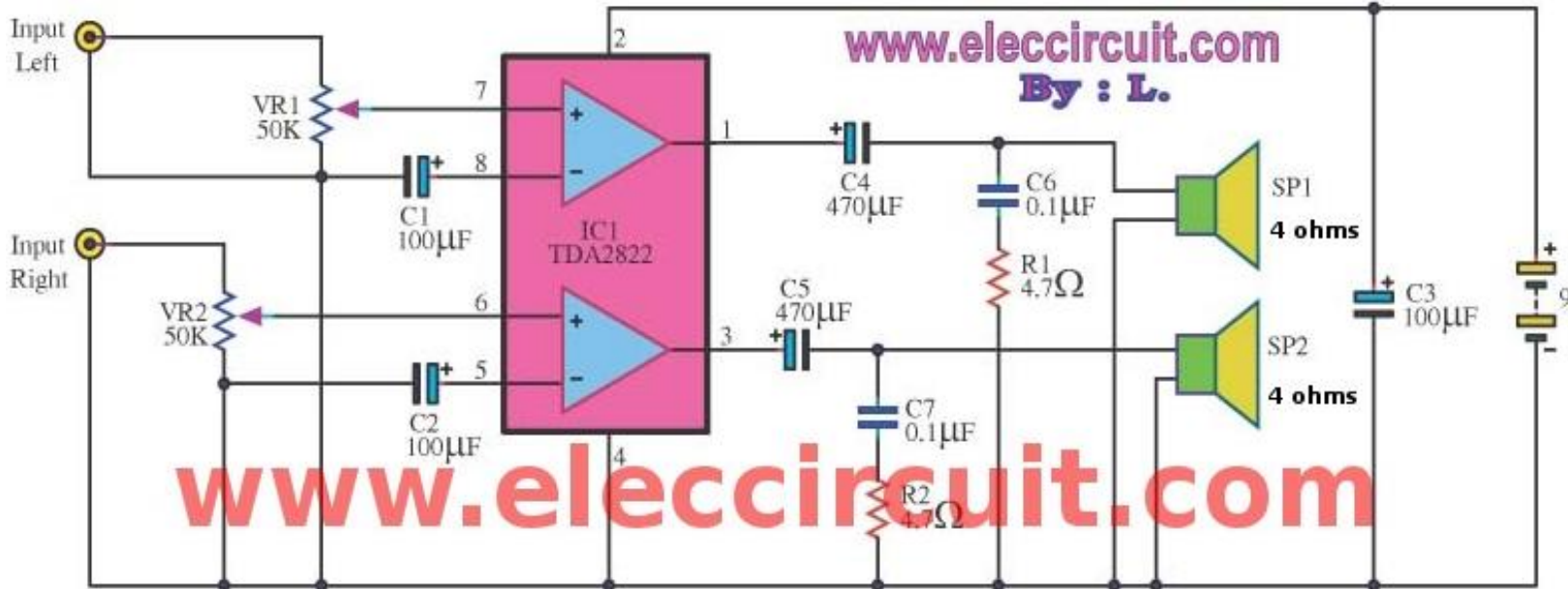
Simple Schematic diagram of a Receiver. *Identify components.*



Requirement 2A

A PRACTICAL CIRCUIT DIAGRAM (SCHEMATIC)

Simple Audio Amplifier with Operational Amplifier (Op Amp) chip



Multiple components such as transistors can be built into a single chip of silicon. In this case, several of these “Building blocks” of components are used together with a few external parts, to build a simple stereo amplifier circuit.





Electronics Merit Badge

Class 2

