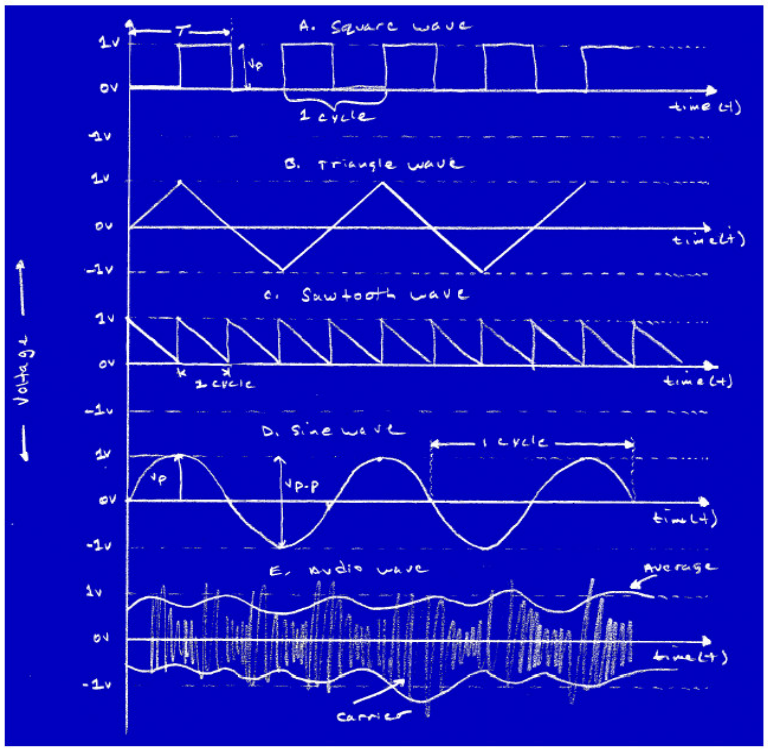
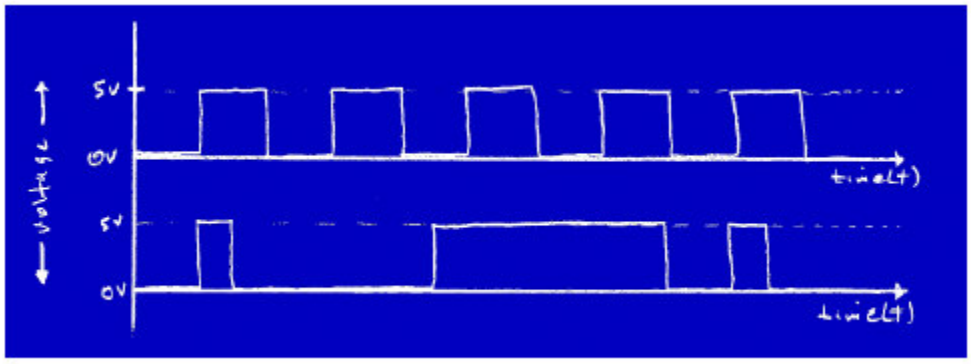
ELETRÔNICA ANALÓGICA E DIGITAL

"ELETRÔNICA VEM DA PALAVRA ELECTRON, PARTICULA SUBATÔMICA QUE TEM CARGA NEGATIVA"

ELETRÔNICA ANALÓGICA

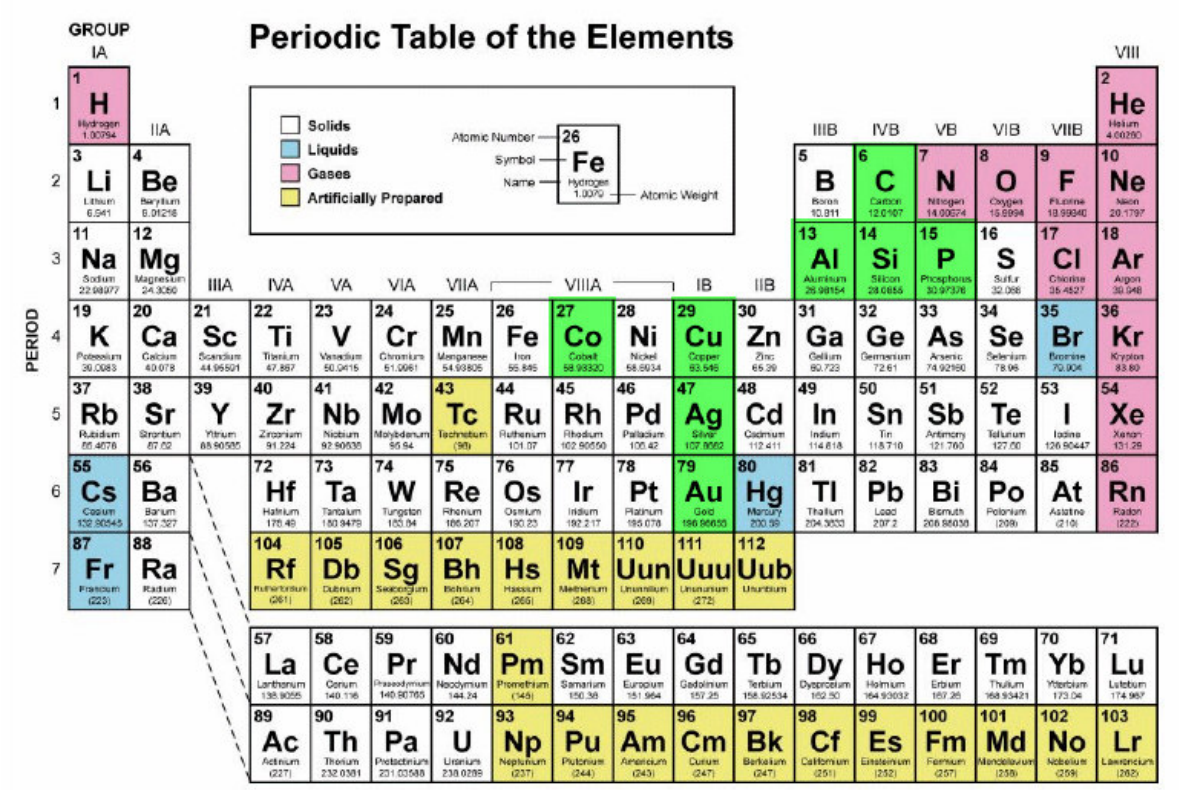


SÃO COMPONENTES DA ELETRÔNICA ANALÓGICA : RESISTORES, CAPACITORES, INDUTORES, DIODOS E TRANSISTORES. UTILIZAM-NOS EM AMPLIFICADORES VELHOS, RADIOS, FONTES DE ALIMENTAÇÃO, ETC.



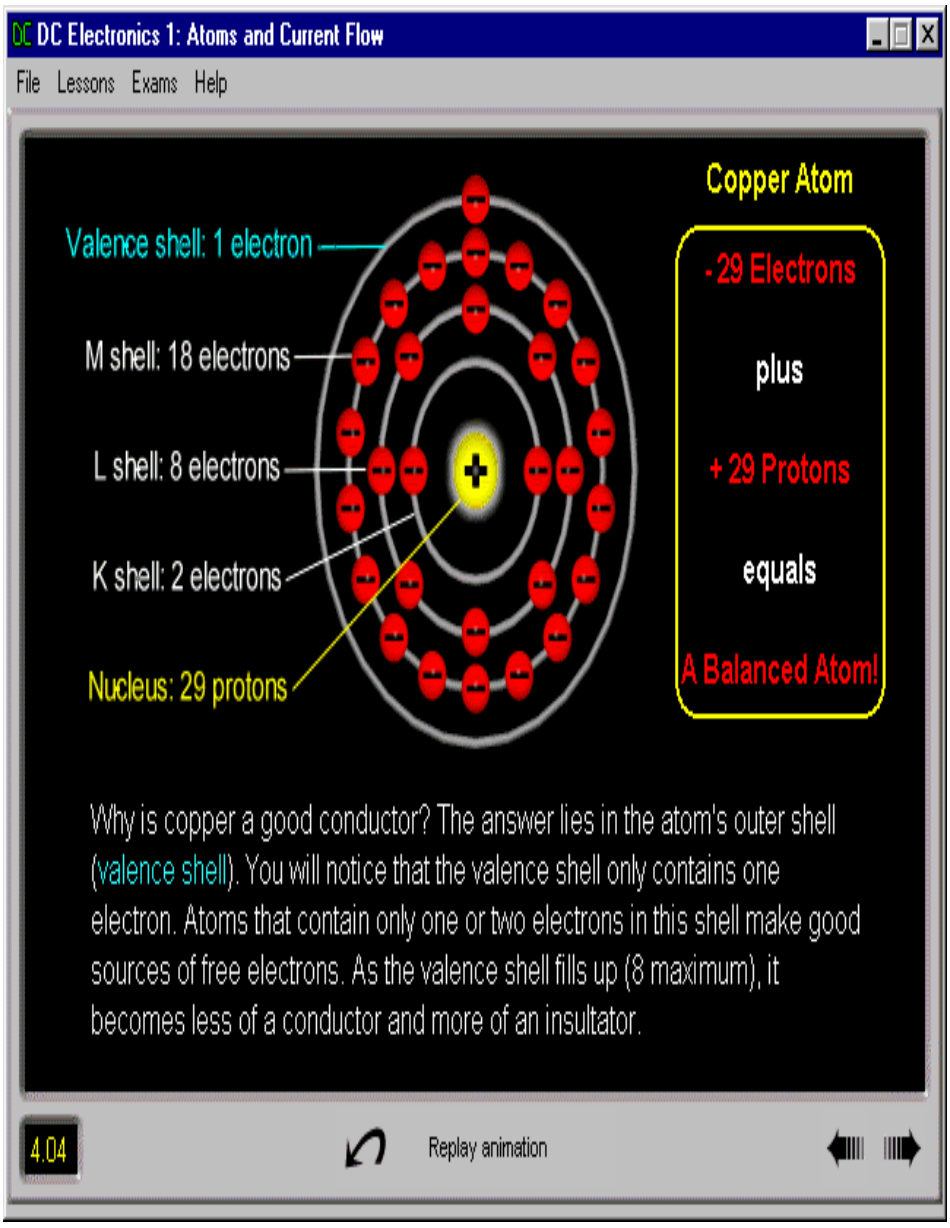
SÃO COMPONENTES DA ELETRÔNICA DIGITAL: PORTAS LOGICAS (E, NÃO, OU). UTILIZAM-NOS EM COMPUTADORES, CALCULADORAS, ETC.

TABELA PERIÓDICA

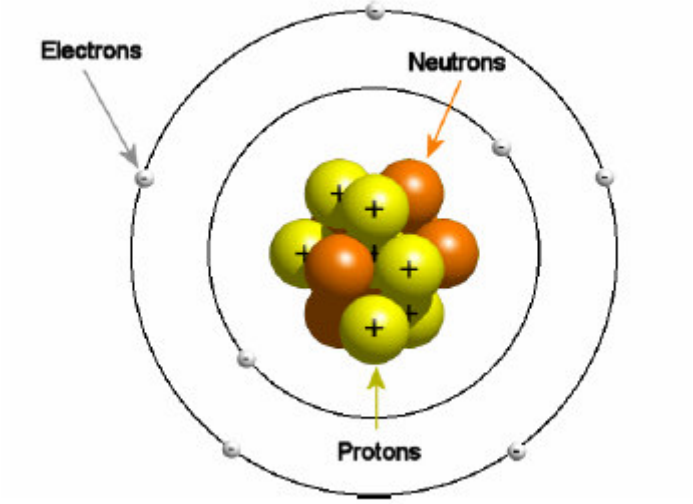


Element Name	*Symbol*	*Use*
Copper	Cu	Conductor
Silver	Ag	Conductor
Gold	Au	Conductor
Aluminum	Al	Conductor
Silicon	Si	Semiconductor
Cobalt	Co	Semiconductor N-type dopant
Phosphorous	P	Semiconductor P-type dopant
Carbon	C	Poor Conductor

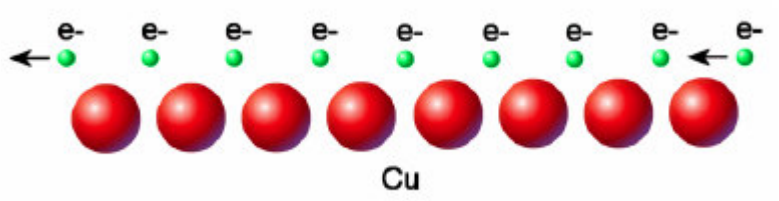
COBRE

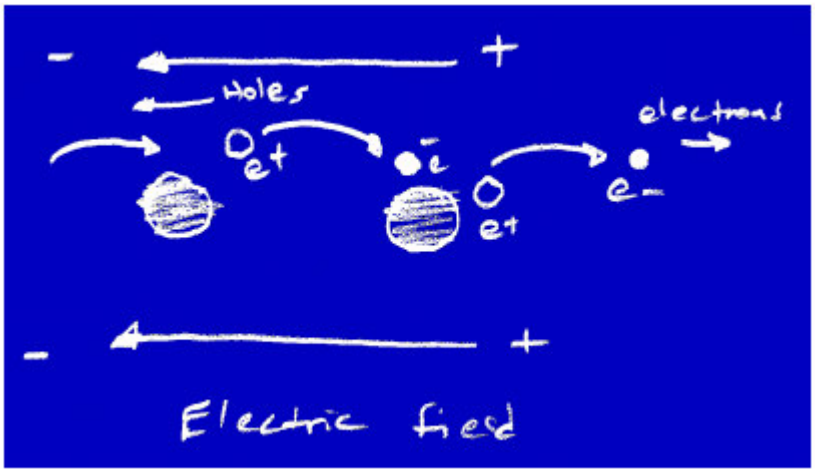

DC Electronics 1: Atoms and Current Flow
File Lessons Exams Help
Copper Atom
Valence shell: 1 electron
M shell: 18 electrons
L shell: 8 electrons
K shell: 2 electrons
Nucleus: 29 protons
- 29 Electrons
plus
+ 29 Protons
equals
A Balanced Atom!
Why is copper a good conductor? The answer lies in the atom's outer shell (valence shell). You will notice that the valence shell only contains one electron. Atoms that contain only one or two electrons in this shell make good sources of free electrons. As the valence shell fills up (8 maximum), it becomes less of a conductor and more of an insultator.
4.04
Replay animation

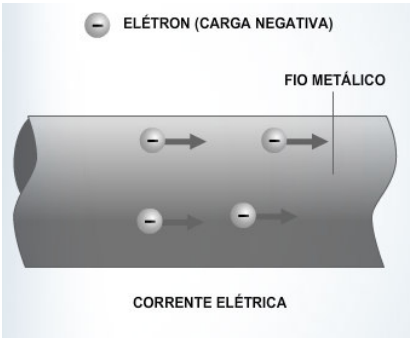
ÁTOMO E CONDUTIVIDADE



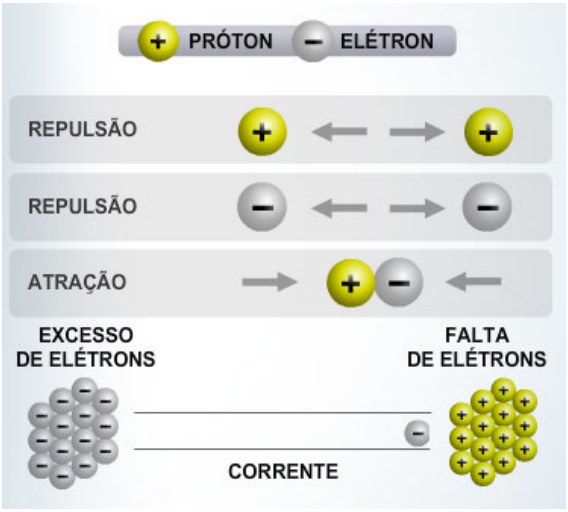
CORRENTE ELÉTRICA

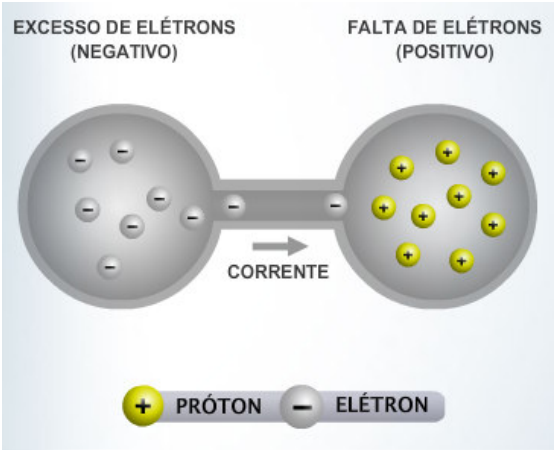


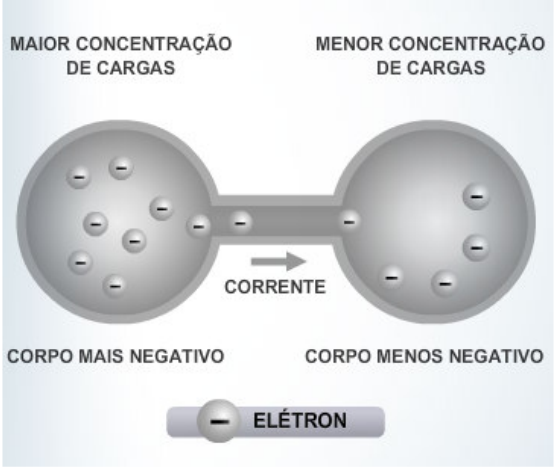


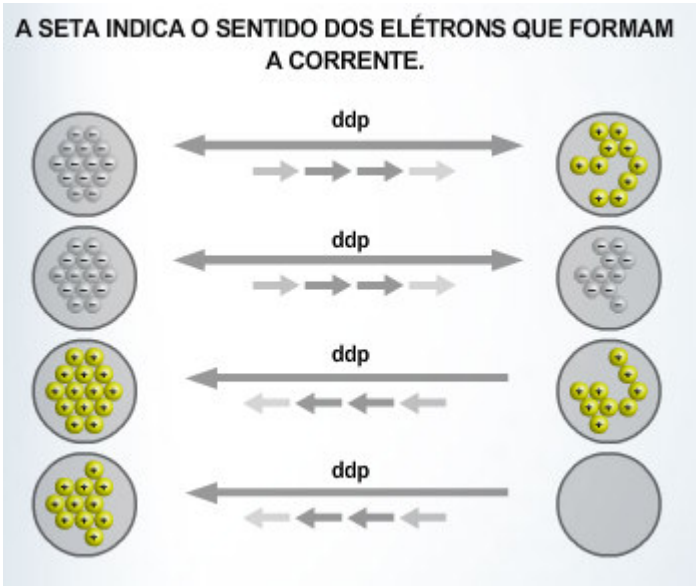


ATRAÇÃO


PRÓTON
ELÉTRON
REPULSÃO
REPULSÃO
ATRAÇÃO
EXCESSO DE ELÉTRONS
FALTA DE ELÉTRONS
CORRENTE


EXCESSO DE ELÉTRONS (NEGATIVO)
FALTA DE ELÉTRONS (POSITIVO)
CORRENTE
PRÓTON
ELÉTRON

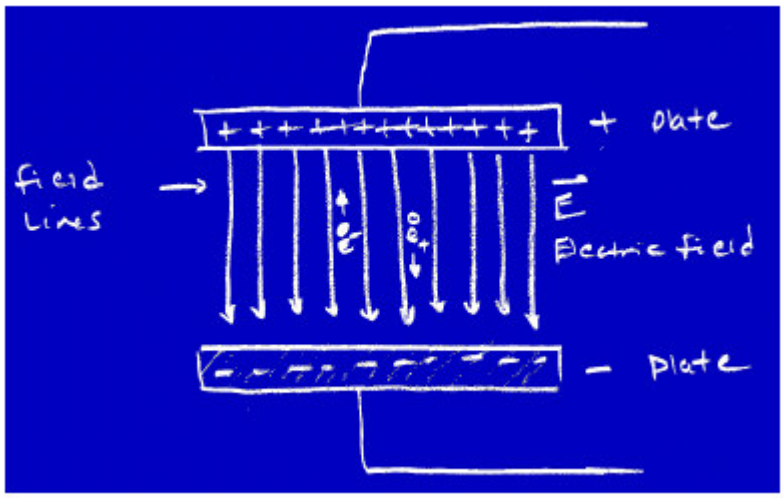

MAIOR CONCENTRAÇÃO DE CARGAS
MENOR CONCENTRAÇÃO DE CARGAS
CORRENTE
CORPO MAIS NEGATIVO
CORPO MENOS NEGATIVO
ELÉTRON



CONSUMO DE CORRENTE

Device/System	*Average Current Drain*
Single Gate in a uProcessor	10nA
Light Emitting Diode	20mA
Digital TTL Chip	30mA
Single Gate in TTL Chip	5mA
LCD Calculator	50mA
27” Television	2A
Personal Computer	5A
Hairdryer	10A

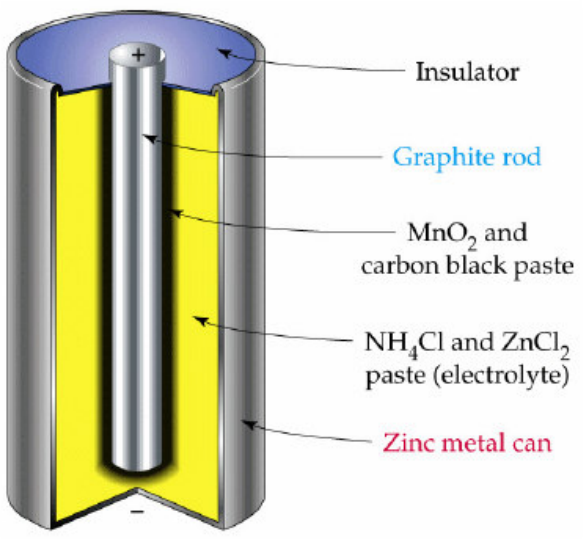
RELAÇÃO DE CORRENTE ELÉTRICA X TENSÃO ELÉTRICA



CADA CARGA ELÉTRICA CRIA UM CAMPO ELÉTRICO, QUANDO VOCÊ TEM UM MONTE DE CARGAS JUNTAS, VOCÊ CRIA UM CAMPO ELÉTRICO QUE É A SOMA DOS CAMPOS ELÉTRICOS INDIVIDUAIS. SE VOCÊ JOGAR UMA CARGA ELÉTRICA NAS LINHAS DE CAMPO (FIELD LINES), O DESLOCAMENTO SERÁ PROPORCIONAL AO CAMPO ELÉTRICO DISPONÍVEL NAS PLACAS (PLATES).

GERANDO TENSÃO ELÉTRICA

QUÍMICO



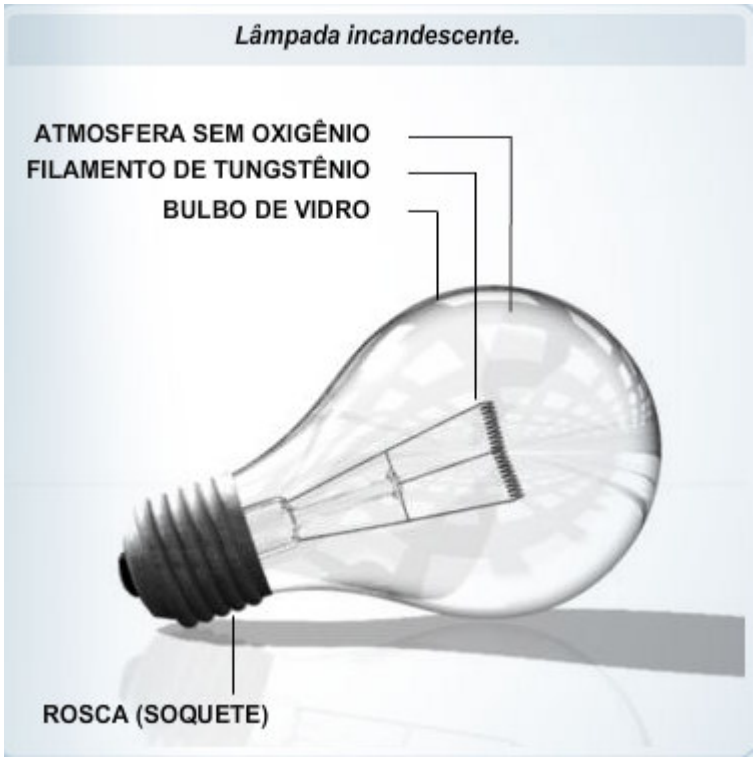
MECÂNICO

ESTÁTICA

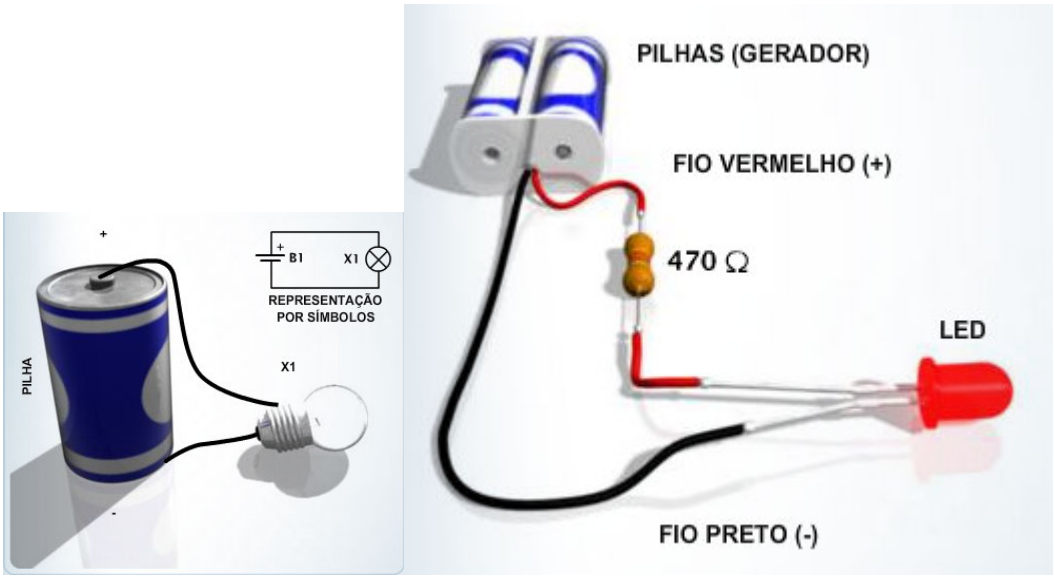
CONVERSÃO DA ENERGIA ELÉTRICA

SECADOR

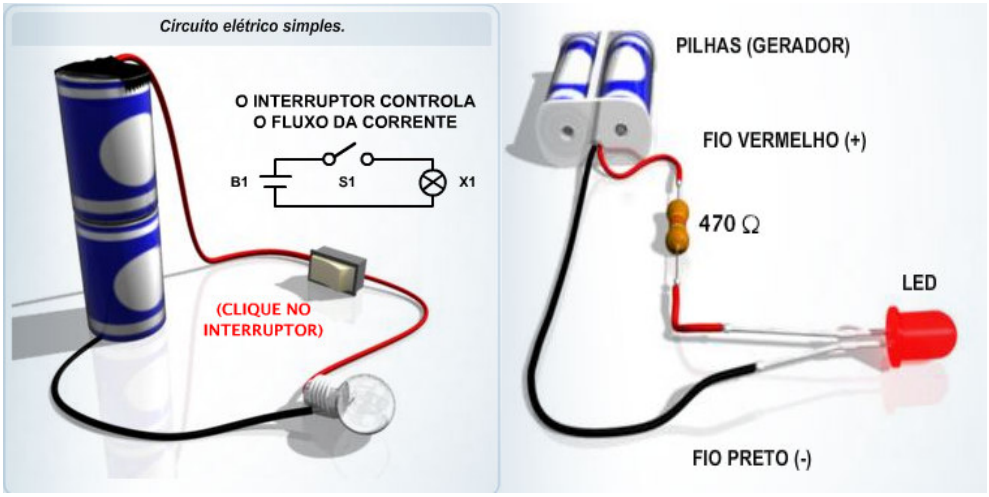
LAMPADA



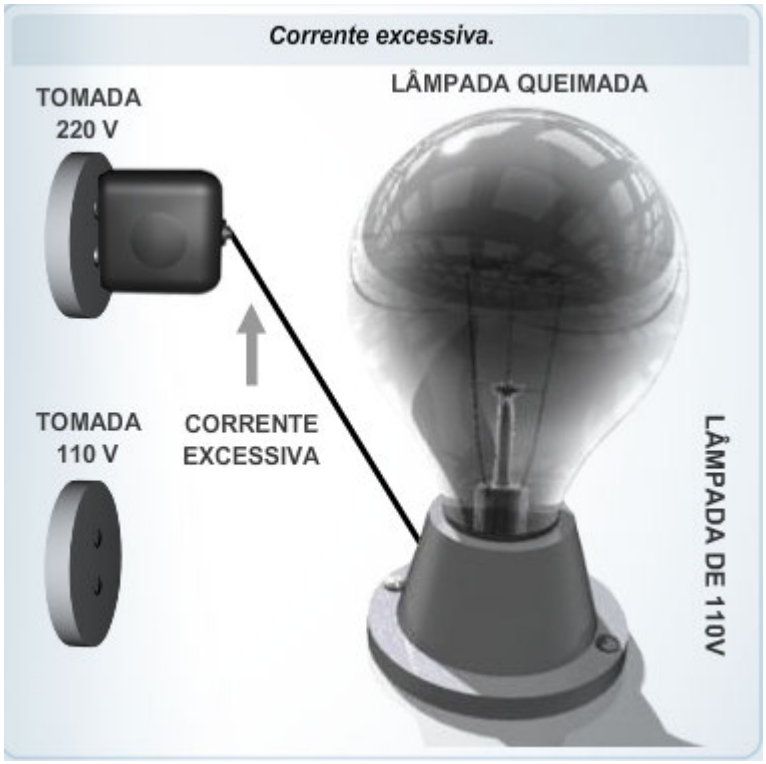
CIRCUITO ELETRICO SIMPLES



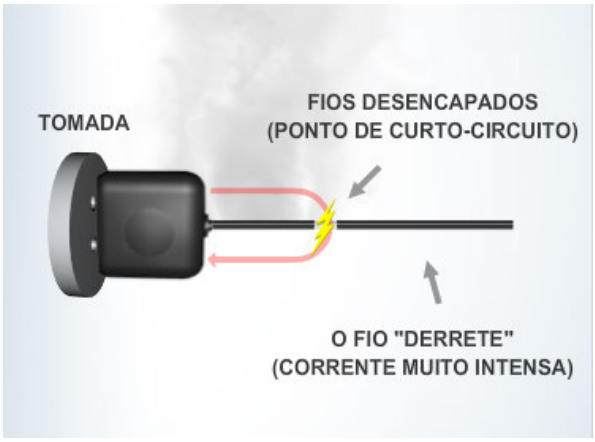
CIRCUITO ELETRICO SIMPLES (COM INTERRUPTOR)



CORRENTE EXCESSIVA (CURTO CIRCUITO)

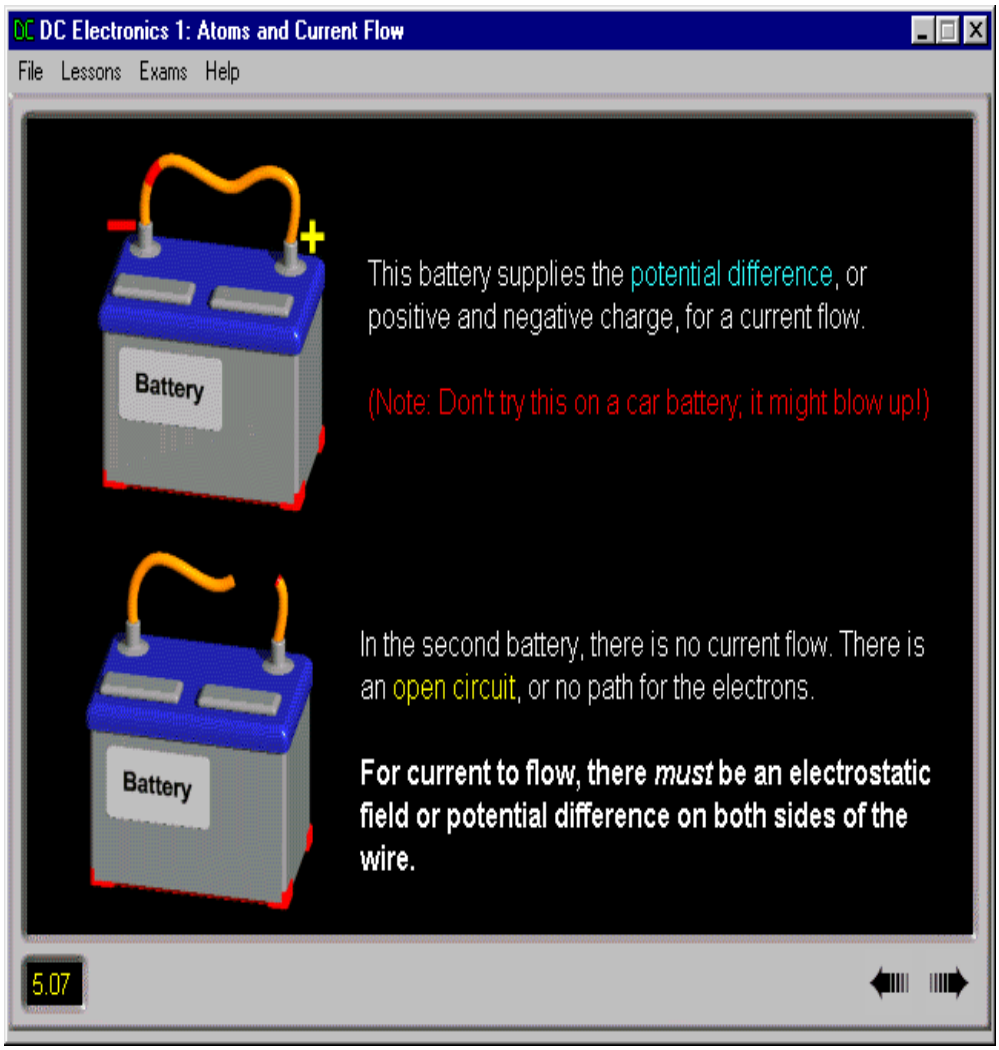


CURTO CLÁSSICO



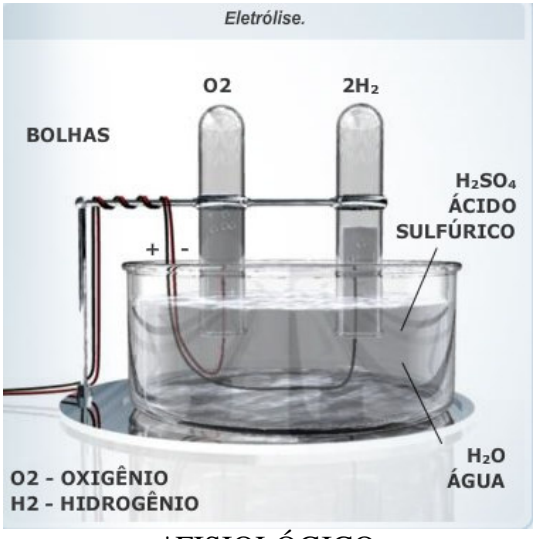
OUTRO CURTO

OUTRO CURTO

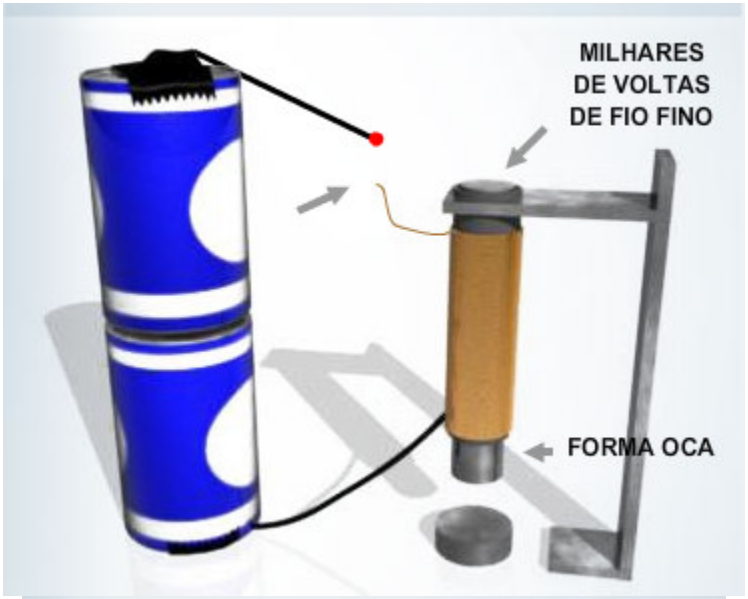

DC Electronics 1: Atoms and Current Flow
File Lessons Exams Help
Battery
This battery supplies the potential difference, or positive and negative charge, for a current flow.
(Note: Don't try this on a car battery; it might blow up!)
Battery
In the second battery, there is no current flow. There is an open circuit, or no path for the electrons.
For current to flow, there must be an electrostatic field or potential difference on both sides of the wire.
5.07

EFEITOS DA CORRENTE ELÉTRICA

*TÉRMICO
*QUIMICO



*FISIOLÓGICO
*MAGNÉTICO

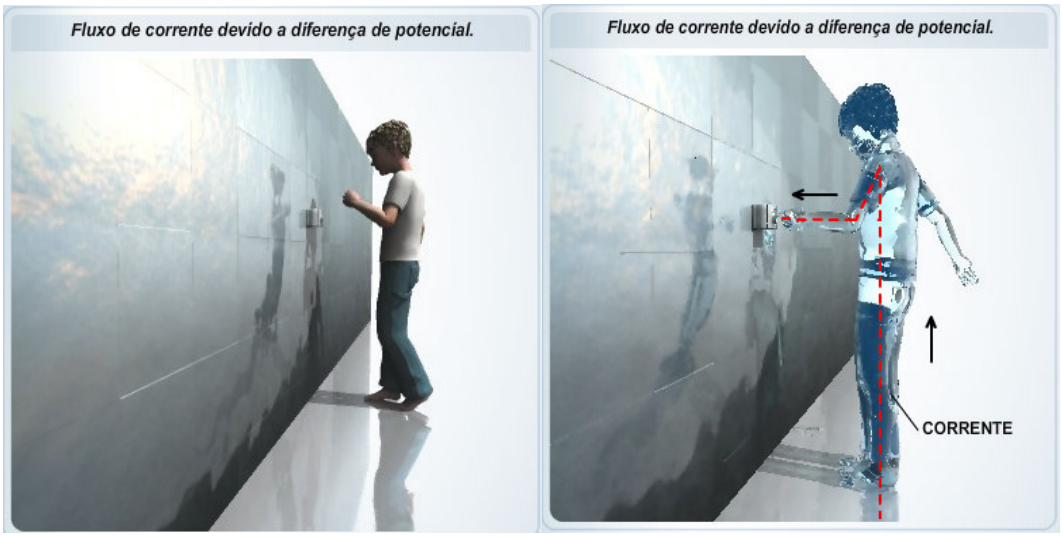

MILHARES
DE VOLTAS
DE FIO FINO
FORMA OCA


MILHARES
DE VOLTAS
DE FIO FINO
FORMA OCA

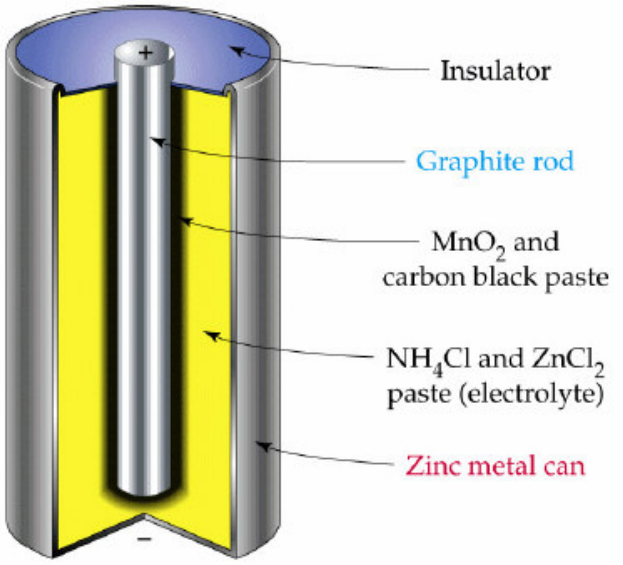

ALFINETES ATRAÍDOS

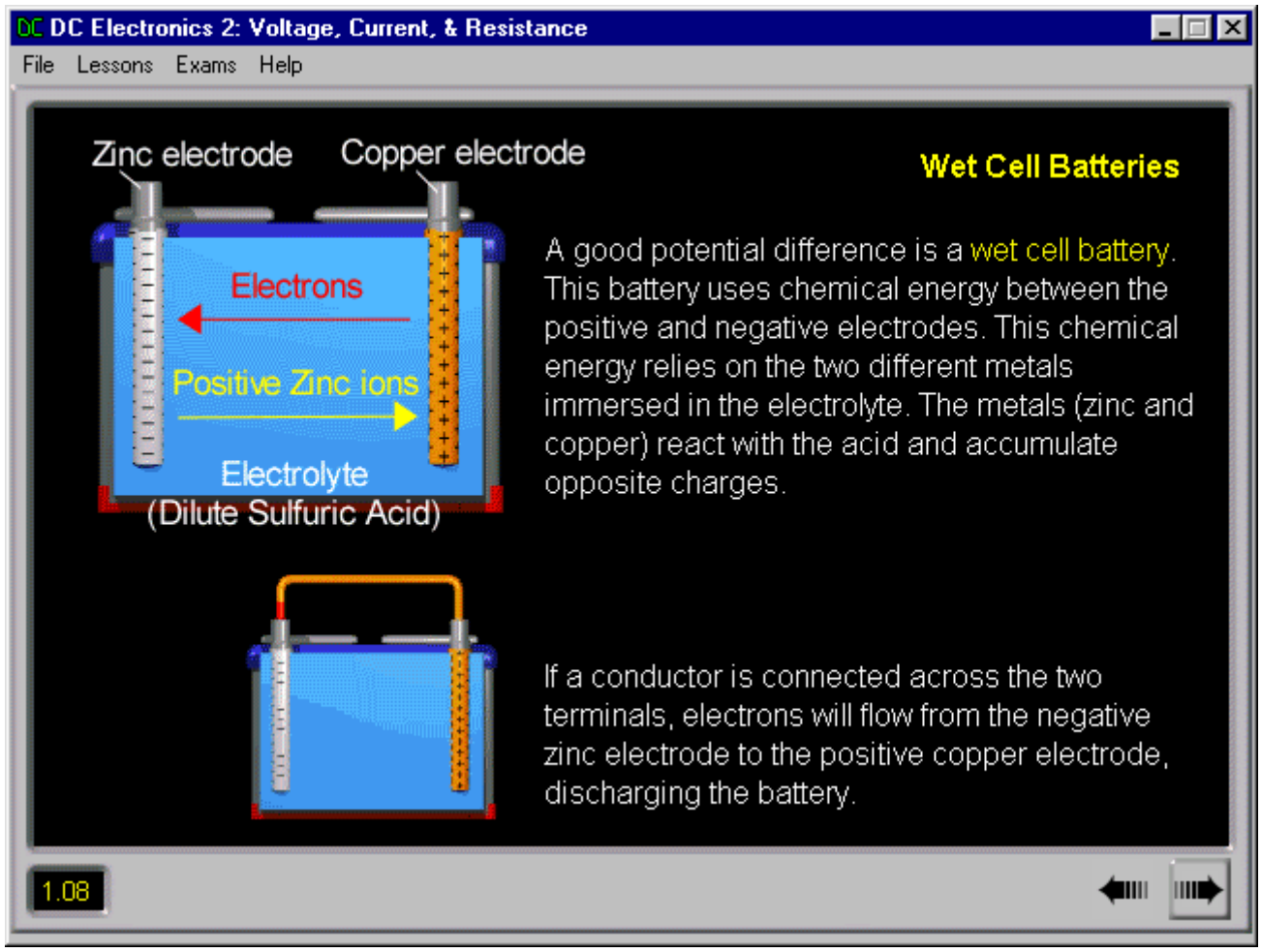
TRABALHANDO COM CONDUTORES (ISOLAÇÃO)

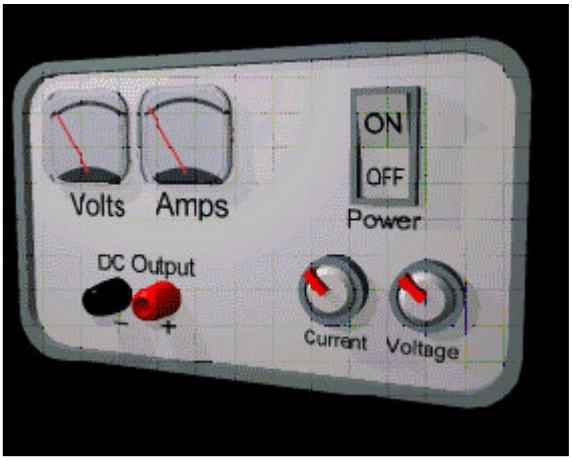
CHOQUE ELÉTRICO



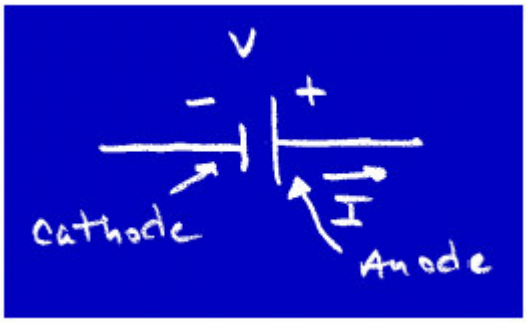
BATERIAS (GERADORES DE CORRENTE)



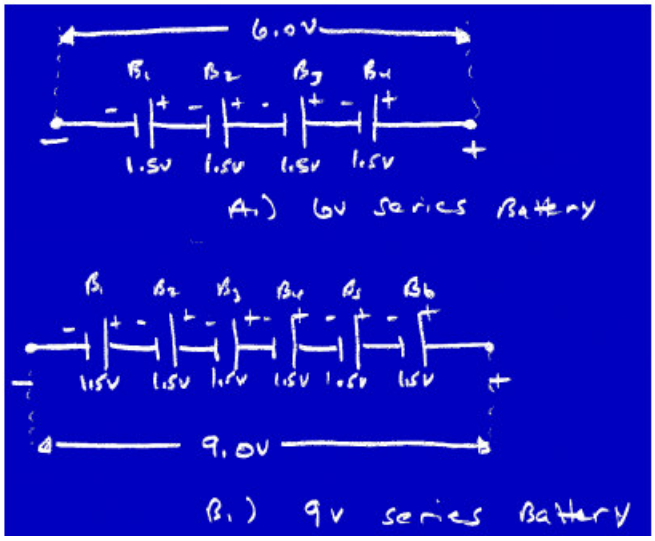

DC Electronics 2: Voltage, Current, & Resistance
File Lessons Exams Help
Zinc electrode
Copper electrode
Wet Cell Batteries
Electrons
Positive Zinc ions
Electrolyte
(Dilute Sulfuric Acid)
A good potential difference is a wet cell battery. This battery uses chemical energy between the positive and negative electrodes. This chemical energy relies on the two different metals immersed in the electrolyte. The metals (zinc and copper) react with the acid and accumulate opposite charges.
If a conductor is connected across the two terminals, electrons will flow from the negative zinc electrode to the positive copper electrode, discharging the battery.
1.08


Volts
Amps
ON
OFF
Power
DC Output
Current
Voltage

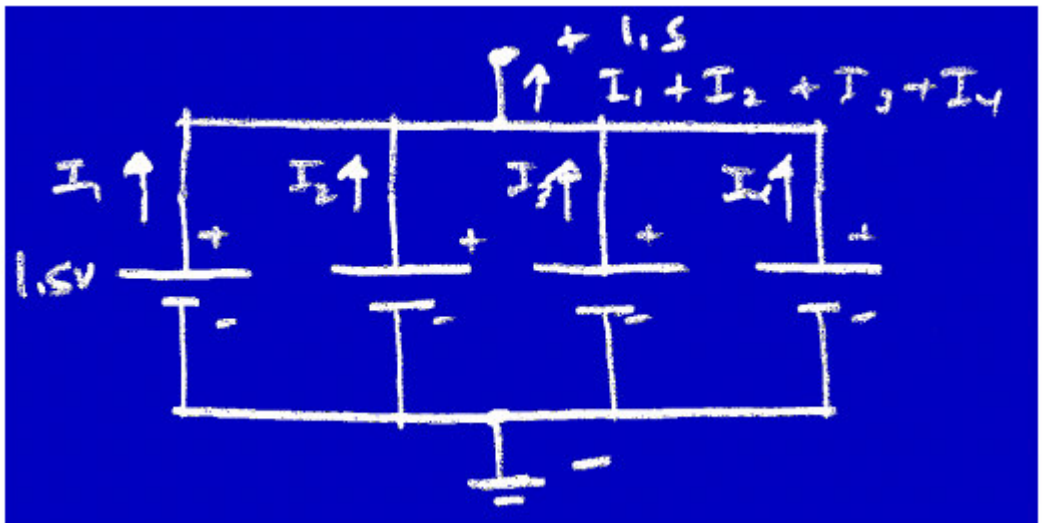
SIMBOLO NA ELETRÔNICA



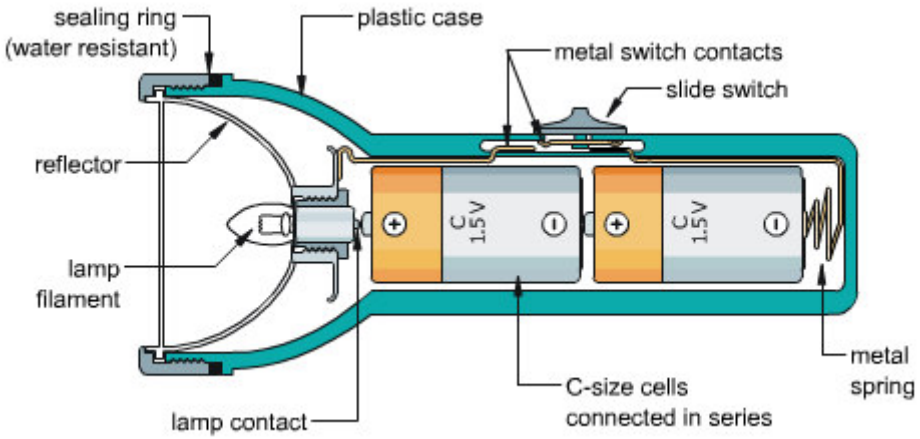
AUMENTANDO A TENSÃO ELÉTRICA E CORRENTE ELÉTRICA



AUMENTANDO A “CAPACIDADE DE PRODUZIR CORRENTE ELÉTRICA”.
A TENSÃO PERMANECE A MESMA

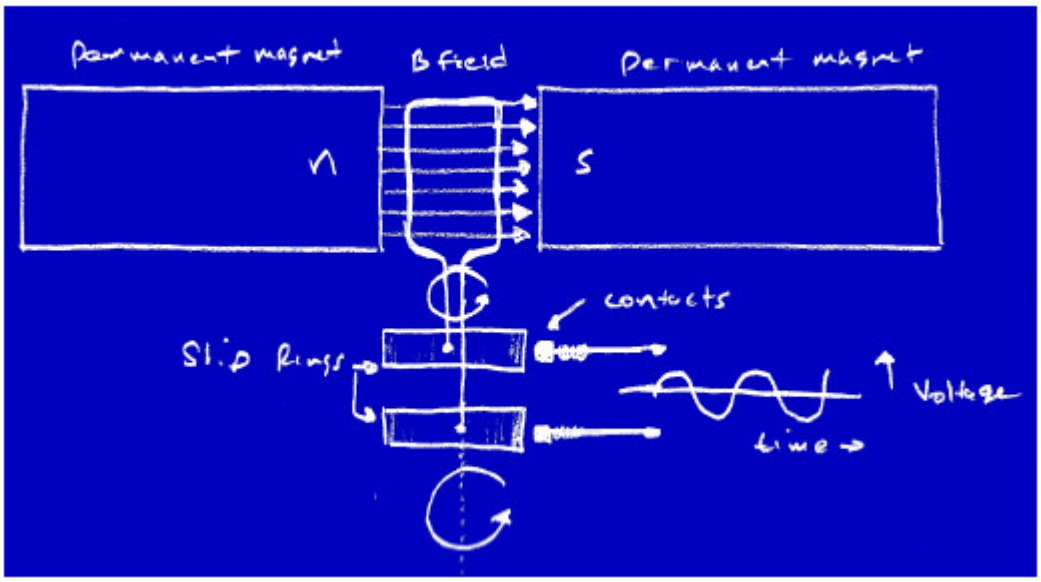


EXEMPLO ASSOCIAÇÃO DE BATERIAS

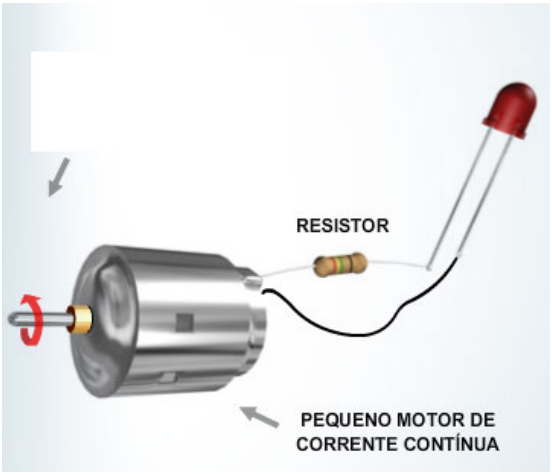


MODELO DE UMA "USINA ELÉTRICA"

A VERDADEIRA USINA HIDRELÉTRICA

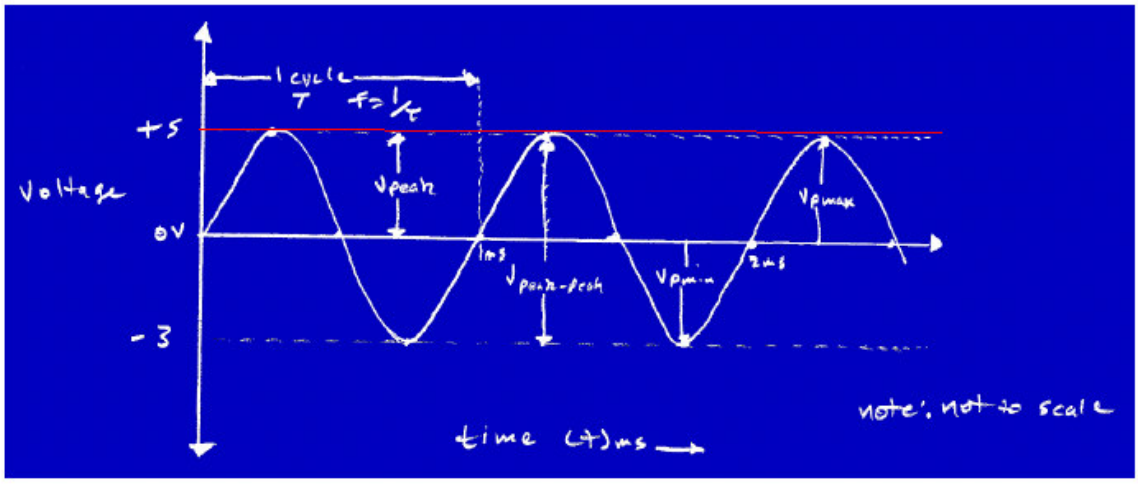


MODELO SIMPLES



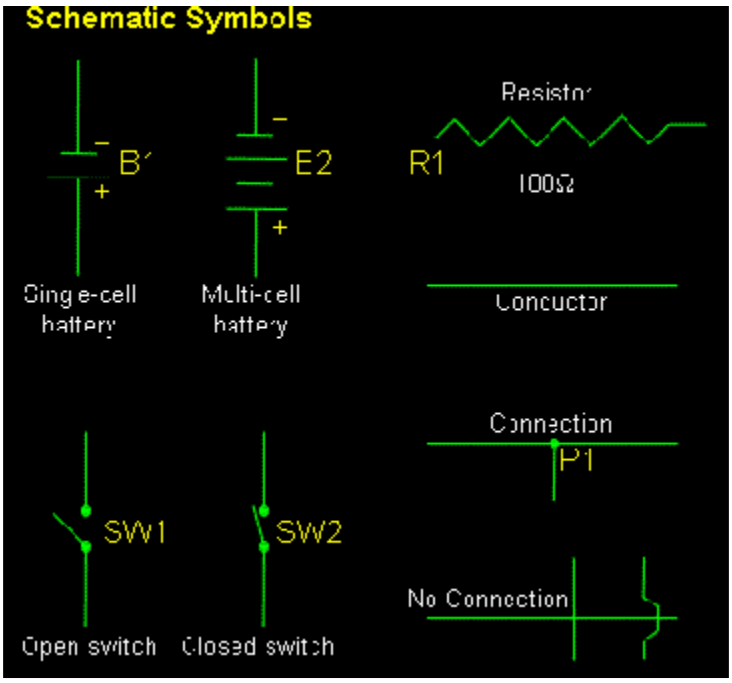
TENSAO GERADO PELA PILHA E USINA NO TEMPO

A/C E D/C



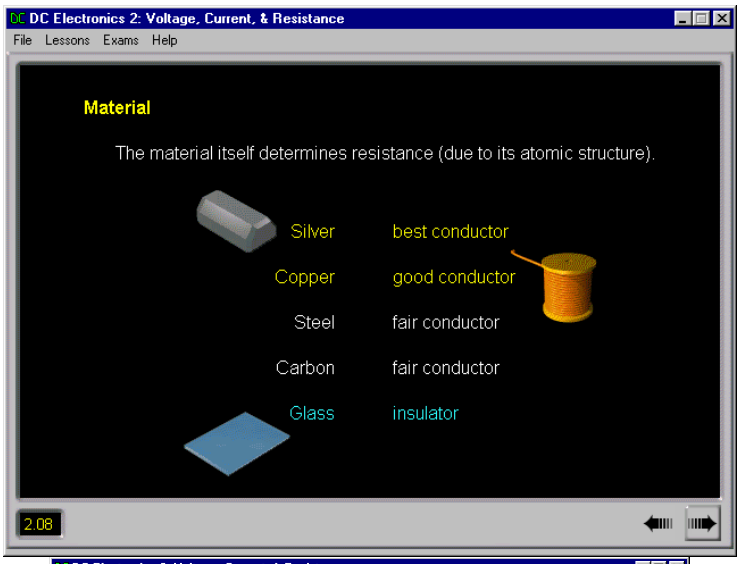
A/C: A TENSÃO VARIA NO TEMPO, HÁ INVERSÃO DE CORRENTE (VEM DAS USINAS HIDRELÉTRICAS)
D/C: A TENSÃO É FIXA NO TEMPO, NÃO HÁ INVERSÃO DE CORRENTE (VEM DAS PILHAS E BATERIAS)

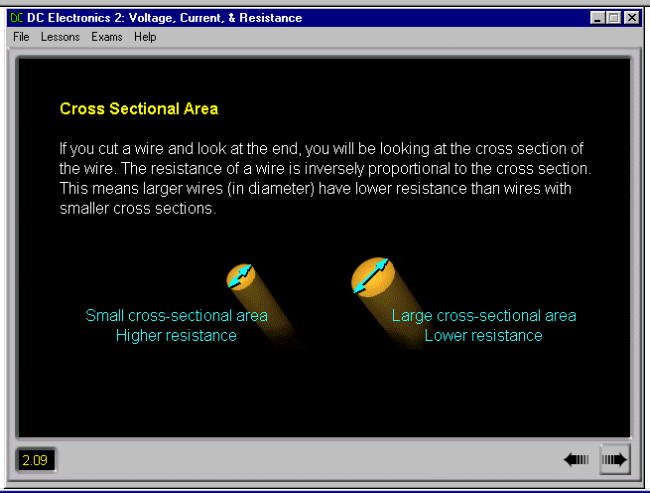
SIMBOLOGIA ELETRÔNICA

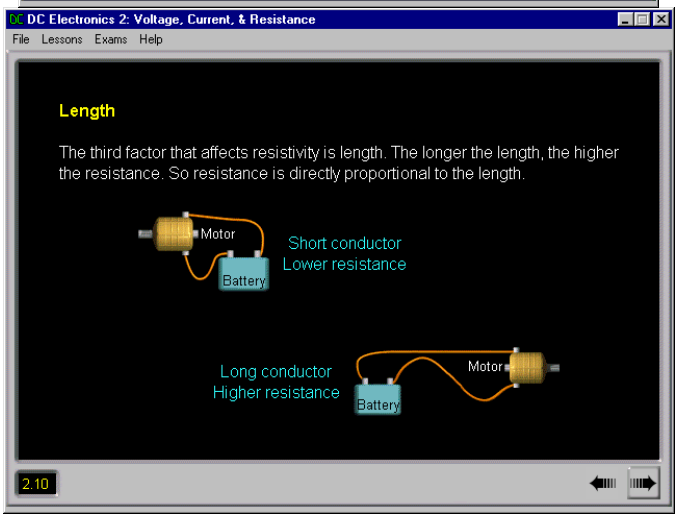


EFEITOS NA CONDUTIVIDADE

- *MATERIAL, ÁREA, COMPRIMENTO, TEMPERATURA*







DC DC Electronics 2: Voltage, Current, & Resistance

File Lessons Exams Help

Temperature

As the temperature rises in most common conducting materials, the resistance increases. As the temperature rises, the atoms increase their motion and cause electrons in the atom to collide with each other. These collisions slow down normal current flow.

Materials that increase in resistance with temperature are said to have a positive temperature coefficient. Materials that decrease in resistance with temperature are said to have a negative temperature coefficient.

Positive temperature coefficients

Cold wire
Lower resistance

Hot wire
Higher resistance

2.11

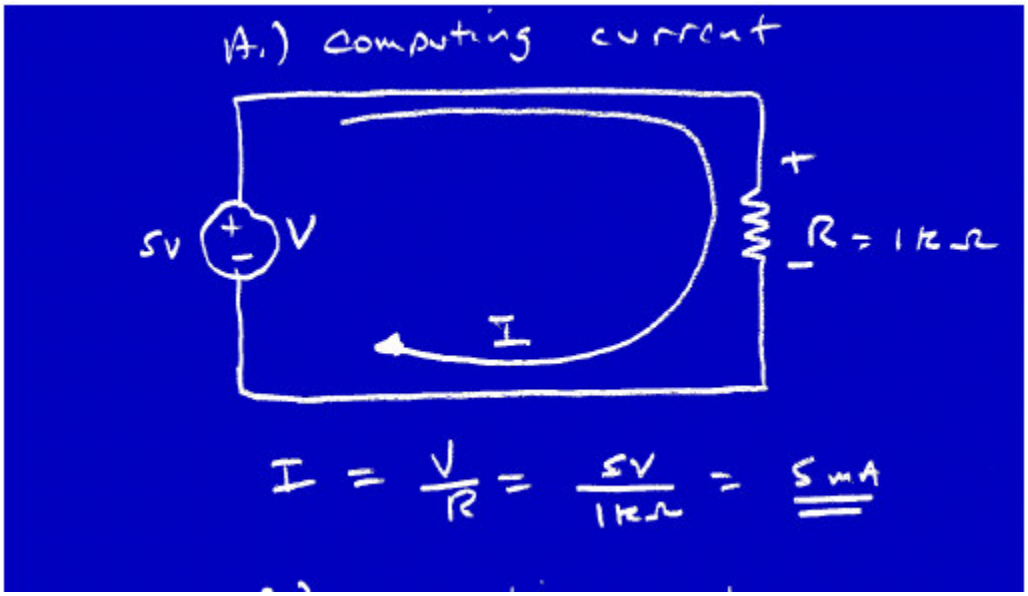
LEI DE OHM

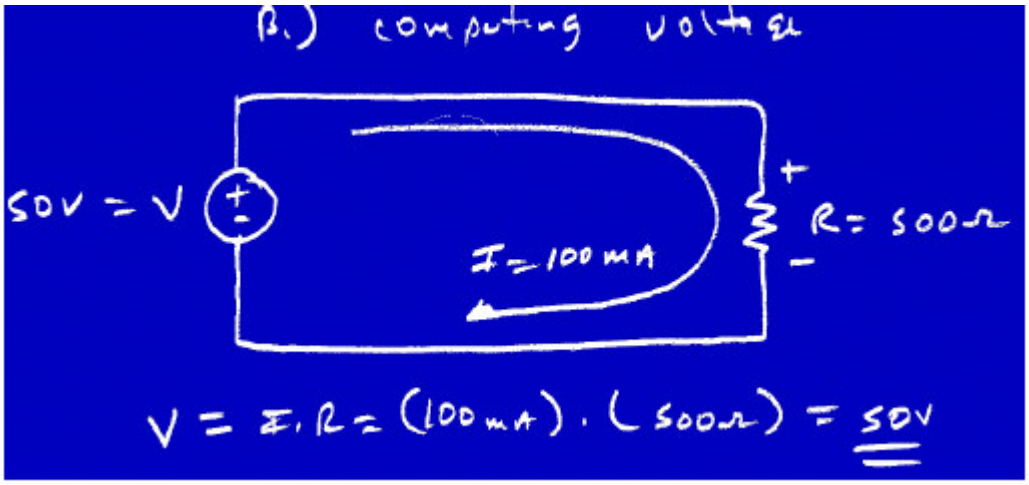
Georg Simon Ohm

V = R*I

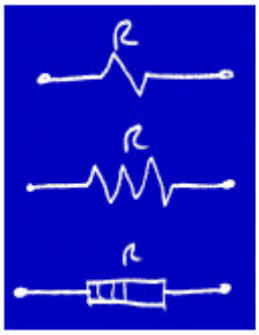
I=V/R

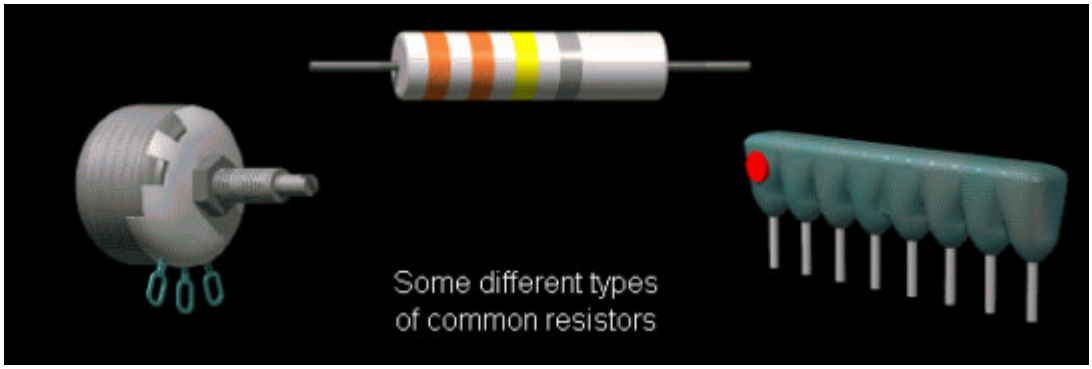
R=V/I



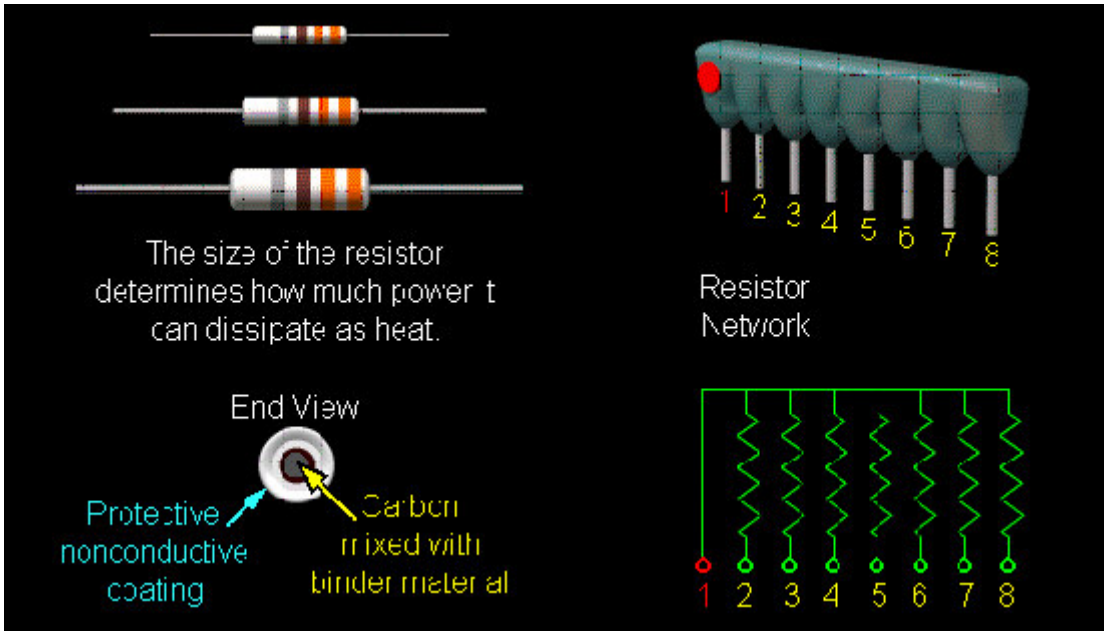


RESISTORES

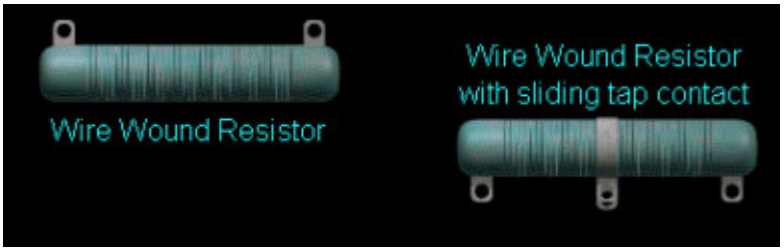




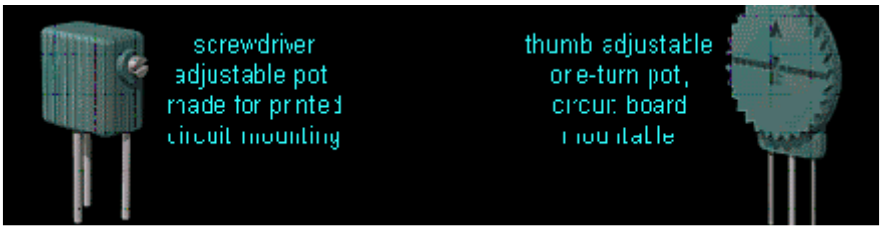
CABORNO

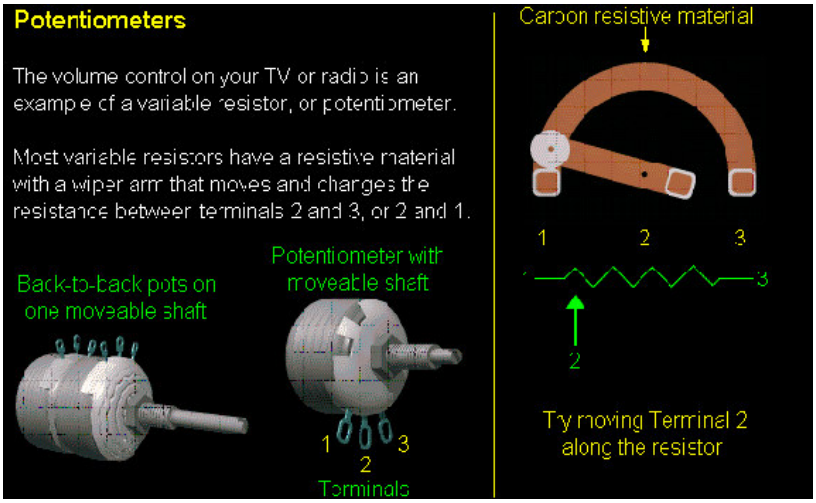


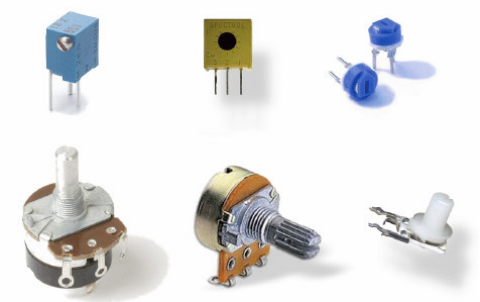
RESISTORES DE FIO



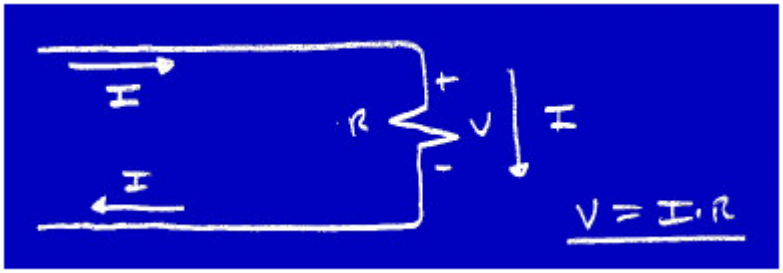
POTENCIOMETROS



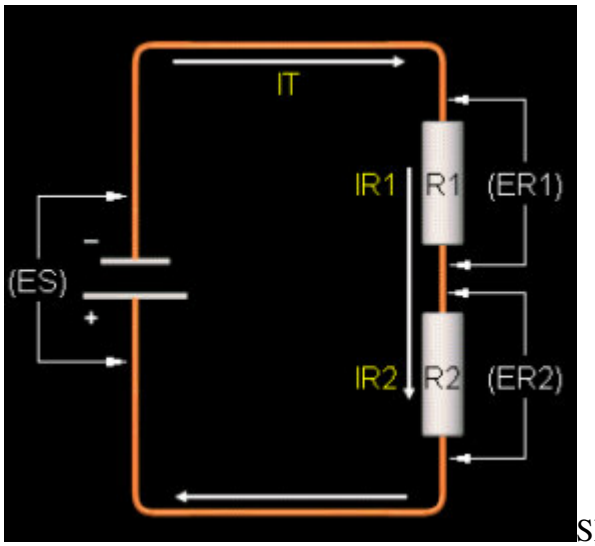




POTENCIAL ELÉTRICO SOBRE UM RESISTOR

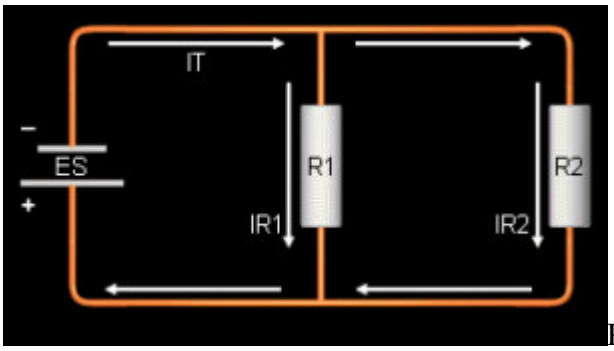


ASSOCIAÇÃO RESISTORES



SÉRIE

- A corrente é mesma
- A tensão depende do valor resistor
- Resistências somam-se (RT = R1 + R2...)

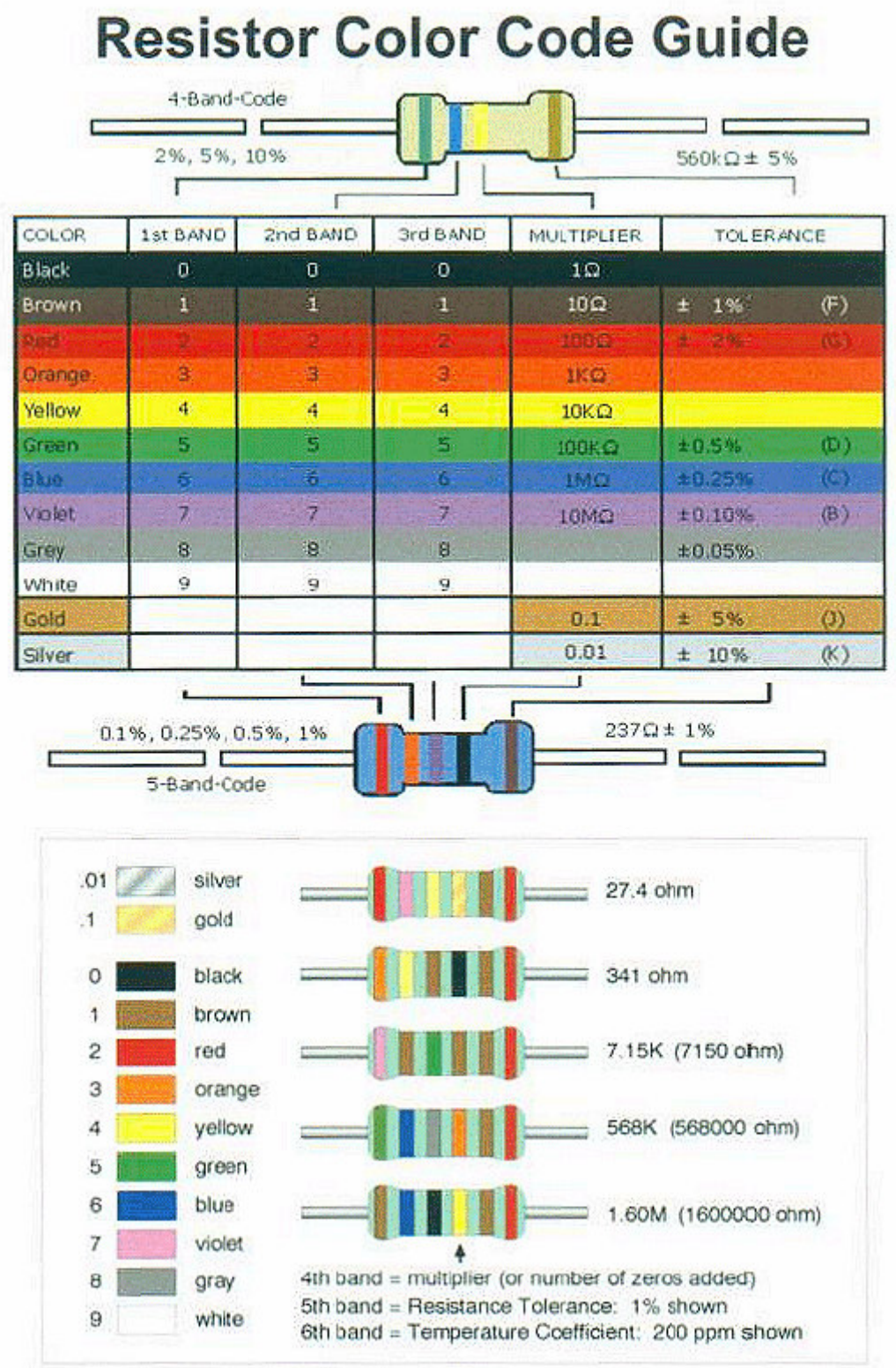


PARALELO

- A corrente não é a mesma
- A tensão não é a mesma
- Resistências dividem-se RT = 1 / (1 / R1 + 1 / R2)...)

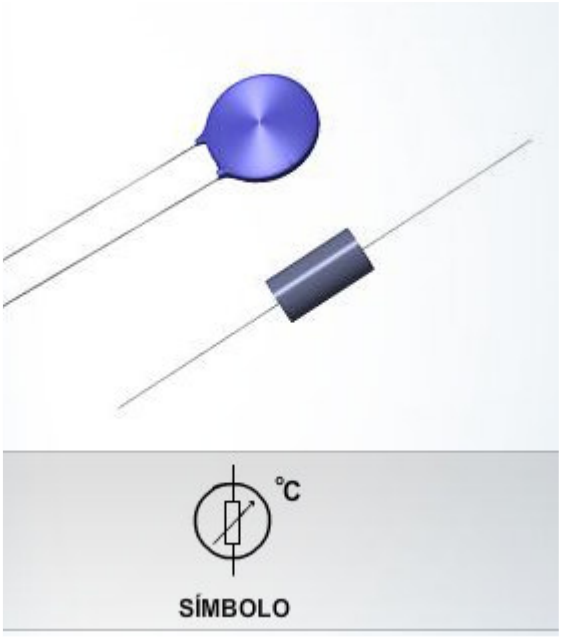
(ENUNCIAR LEIS DA TENSÃO E CORRENTE)

IDENTIFICAÇÃO RESISTOR



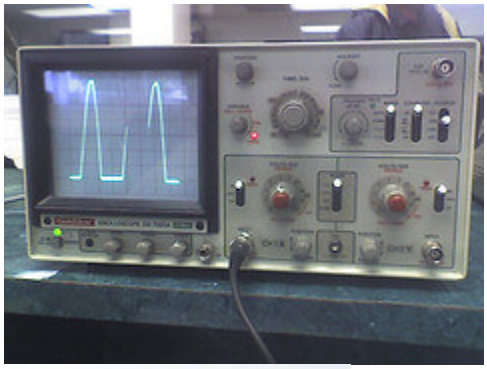
TIPOS DE RESISTORES

- TERMORESISTOR

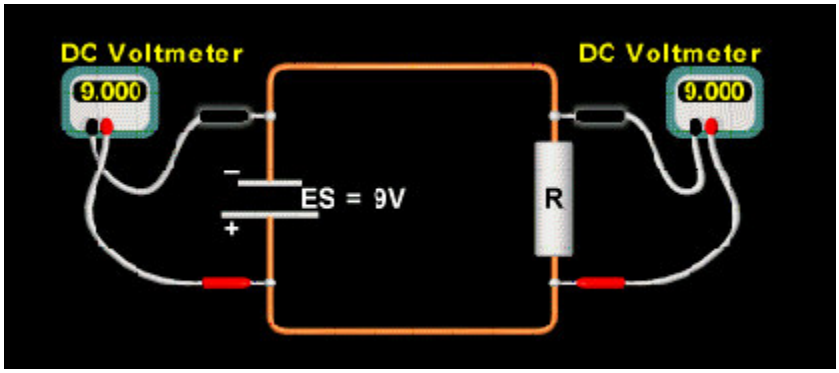


- FOTO RESISTOR

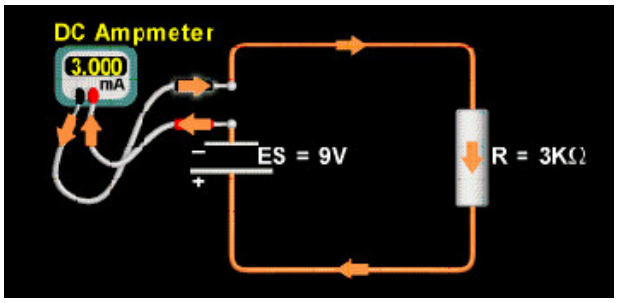
INSTRUMENTOS DE MEDIÇÃO



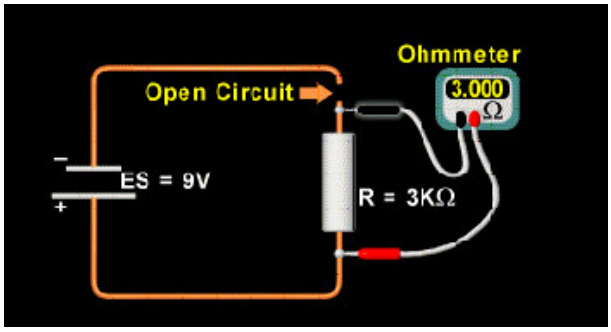
MEDINDO TENSÃO



MEDINDO CORRENTE

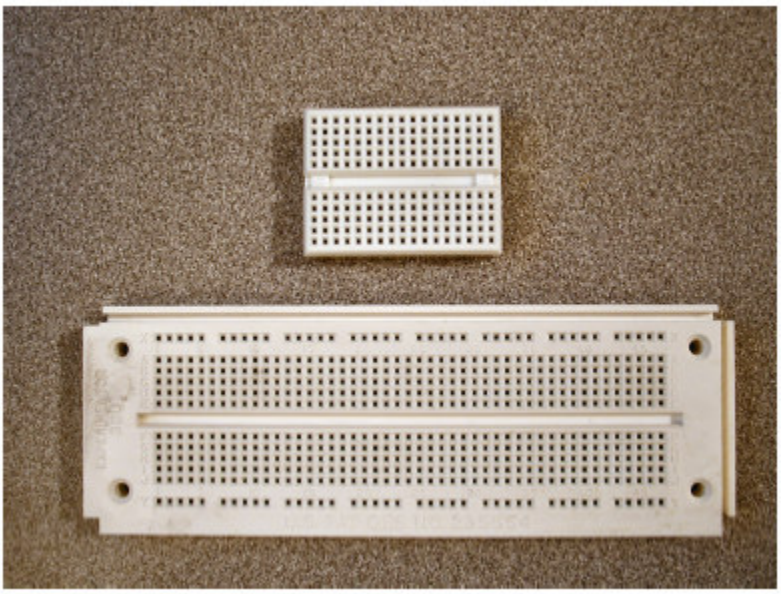


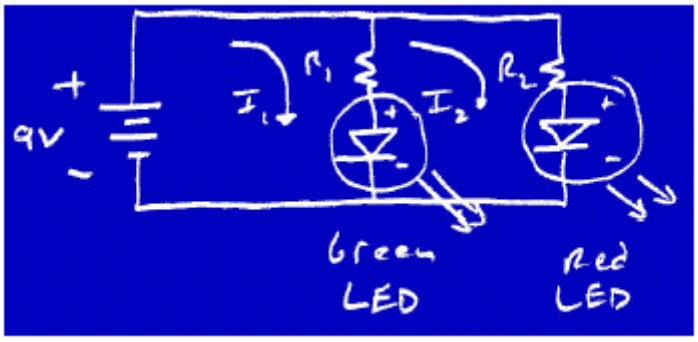
MEDINDO RESISTENCIA

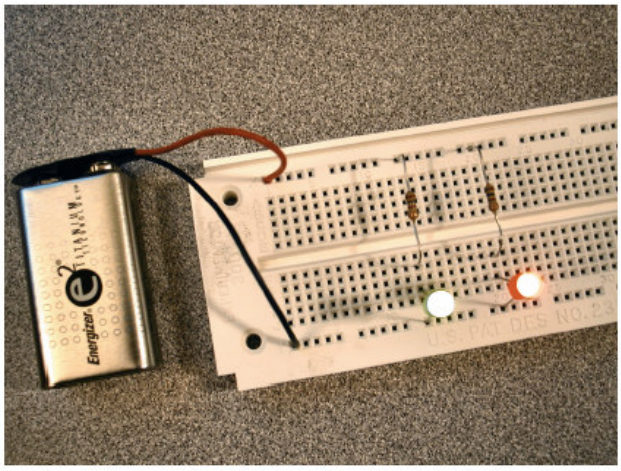


MONTANDO PROTOTIPOS

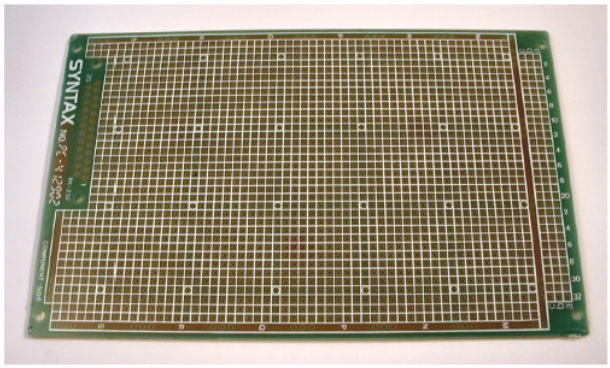
PROTOBOARD

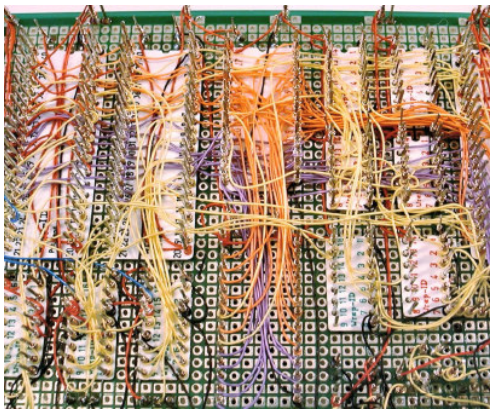



+
9V
~
R_1
I_1
I_2
R_2
Green
LED
Red
LED

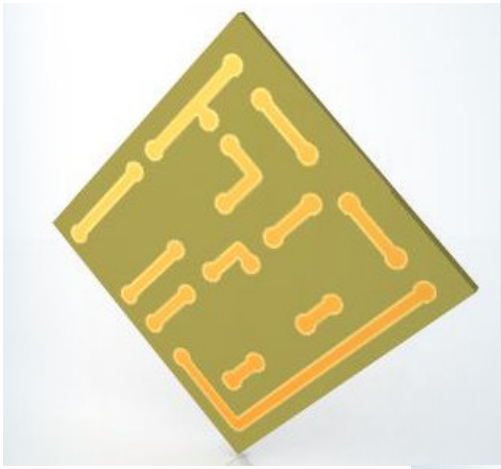

Energizer

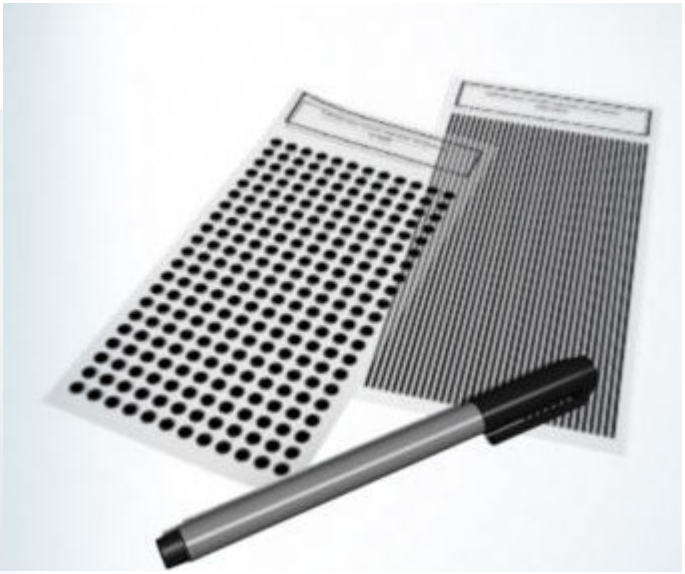
PLACA UNIVERSAL

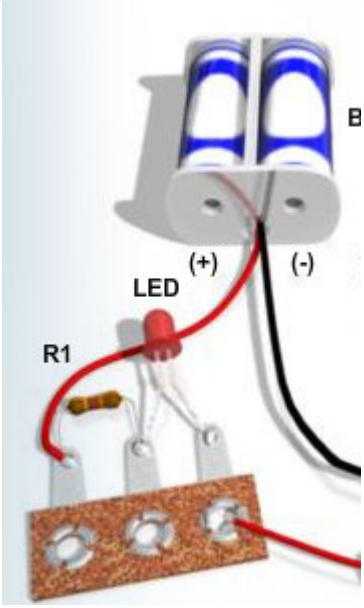




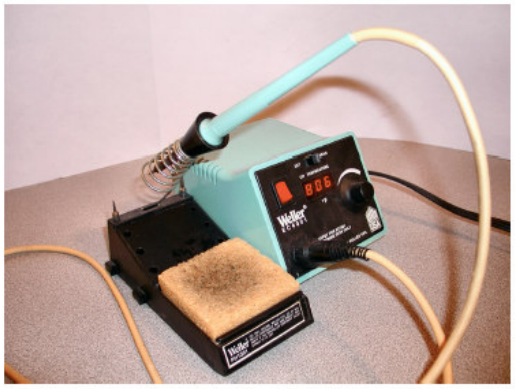
PLACA DE COBRE



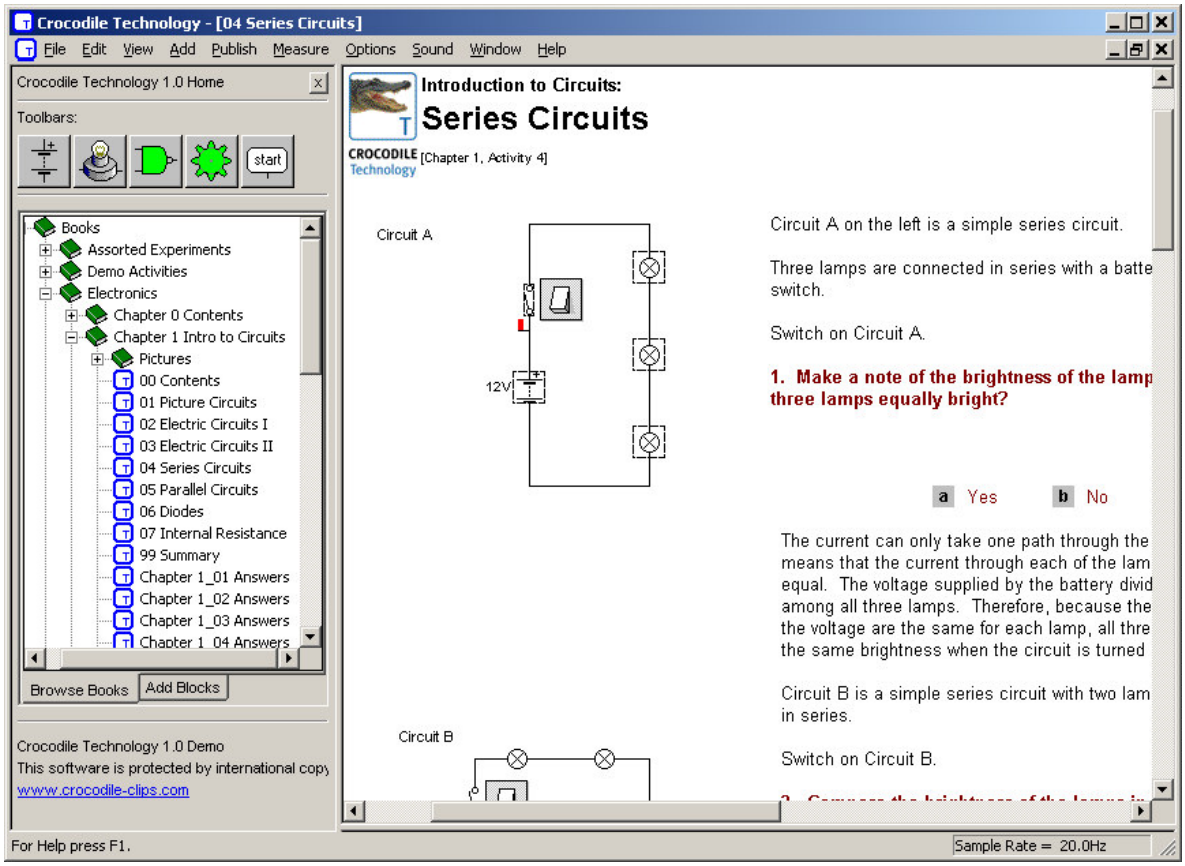


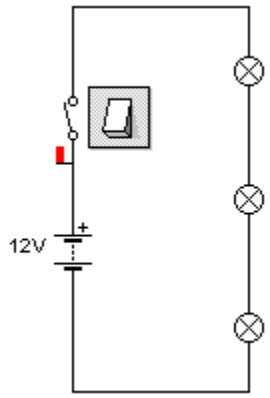

(+)
(-)
LED
R1

ESTAÇÃO DE SOLDA OU ESTANHADOR

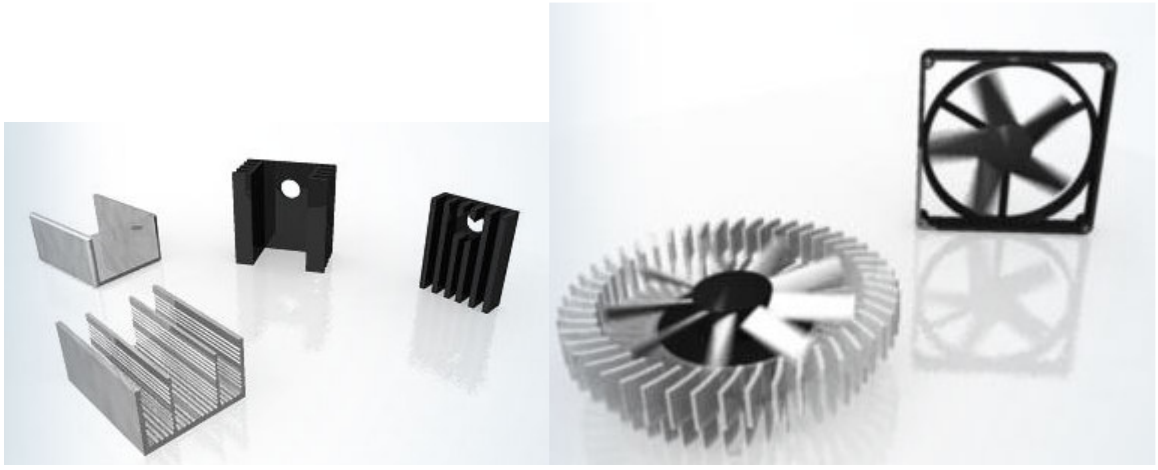


FERRAMENTAS DE SIMULAÇÃO



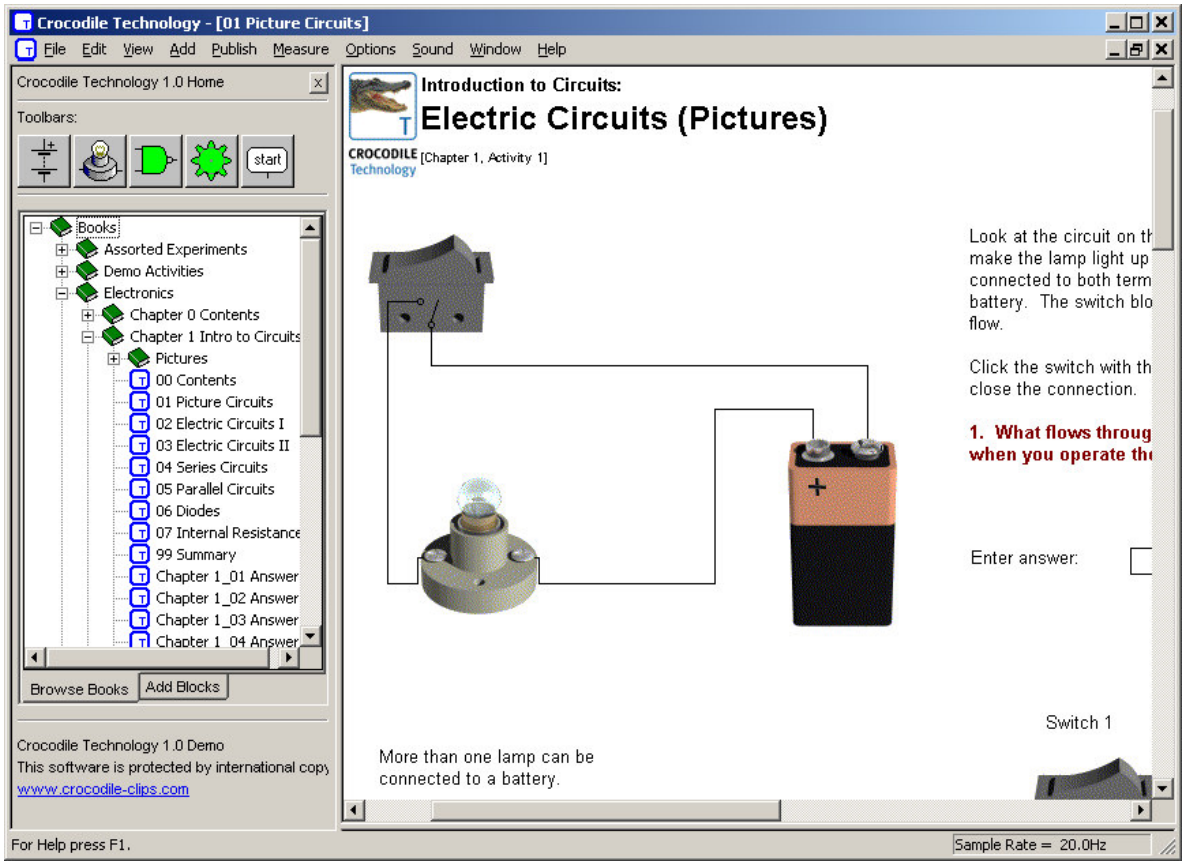


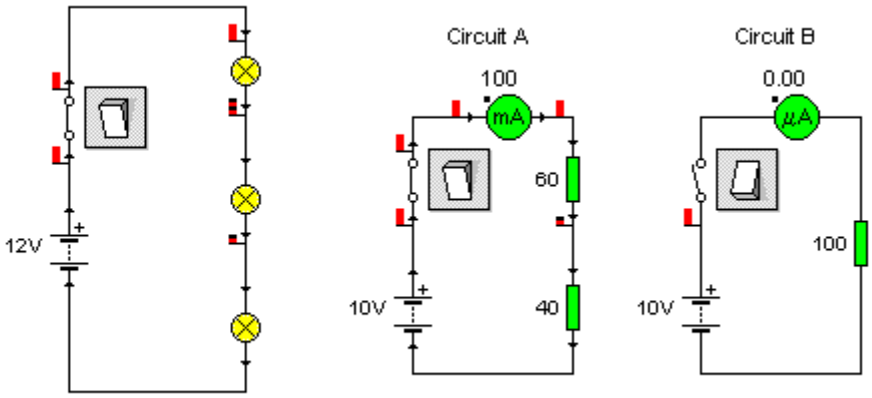
DISSIPADORES DE CALOR



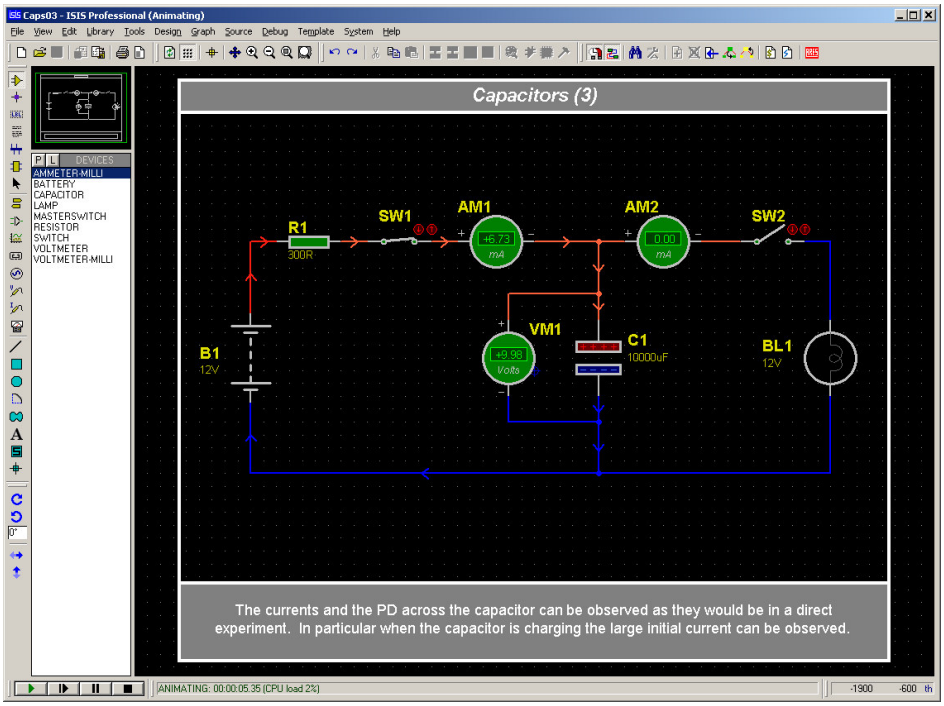
FERRAMENTAS DE SIMULAÇÃO

CROCODILE CLIPS

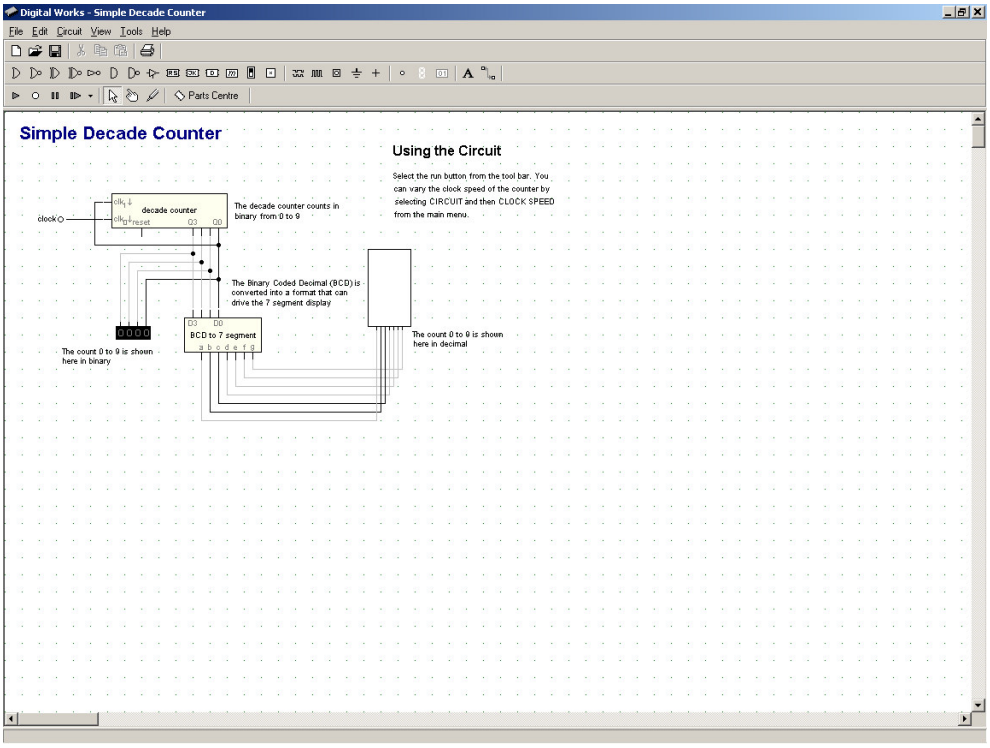




PROTEUS

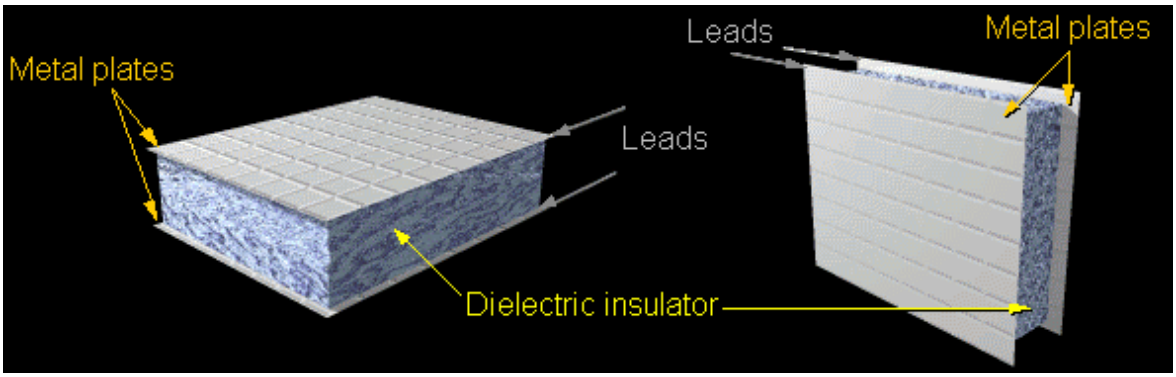


DIGITAL WORKS

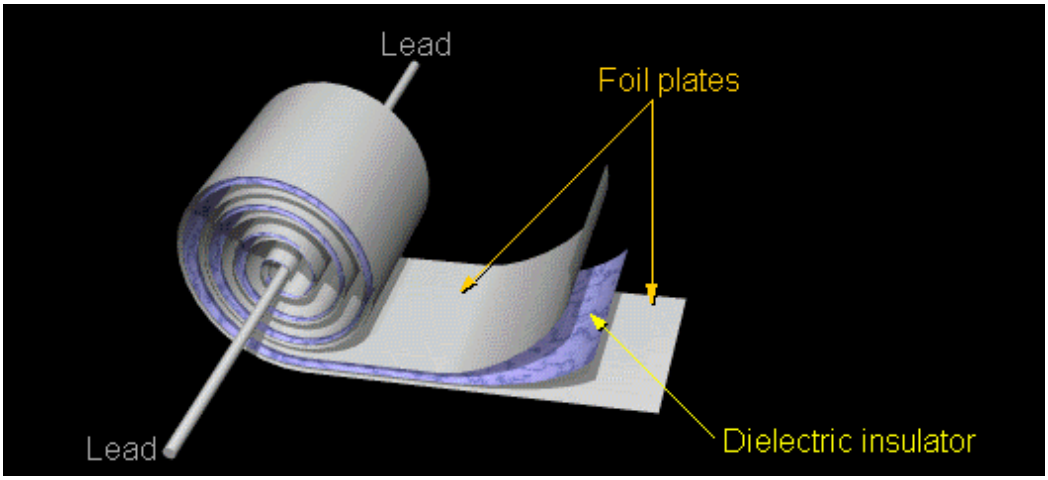


CAPACITORES

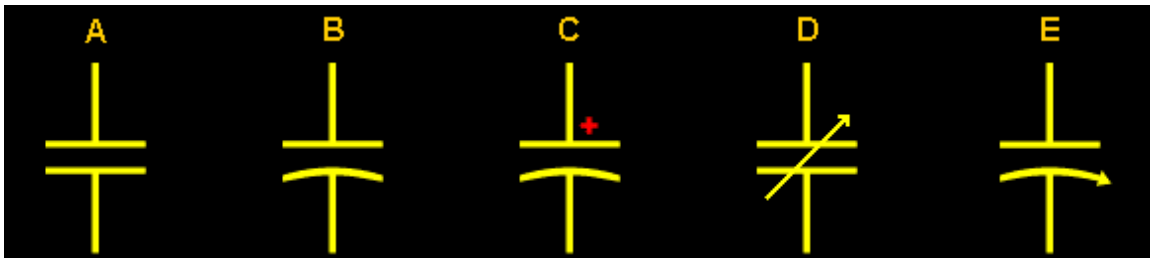
CAPACITORES PODEM ARMAZENAR ENERGIA E DEPOIS LIBERAR



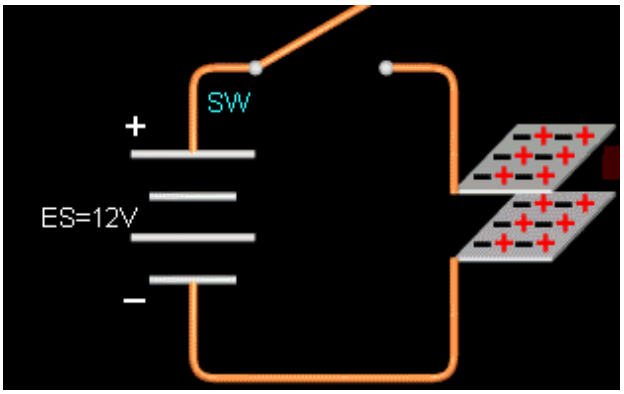
CAPACITOR TUBULAR

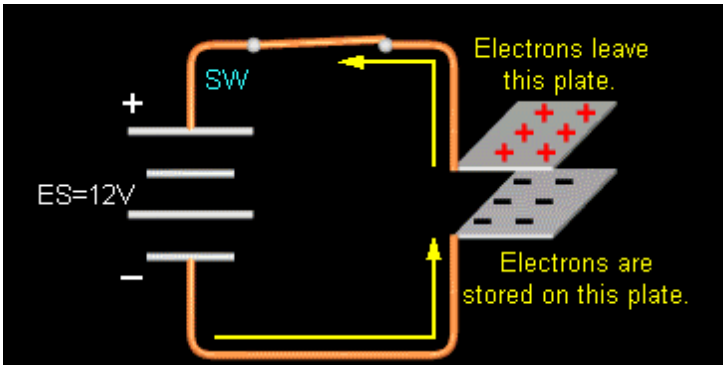


SIMBOLOGIA CAPACITOR

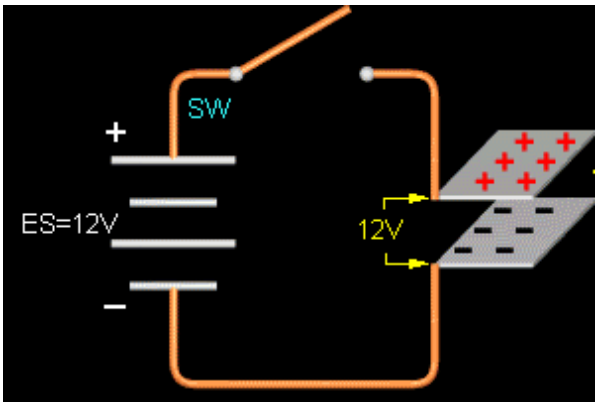


CARREGANDO O CAPACITOR

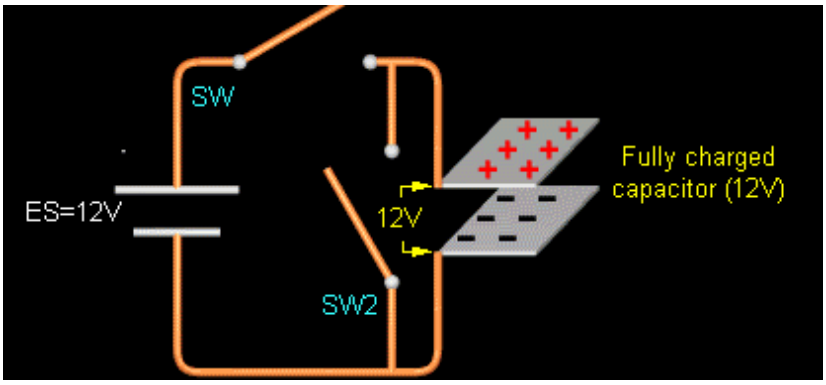


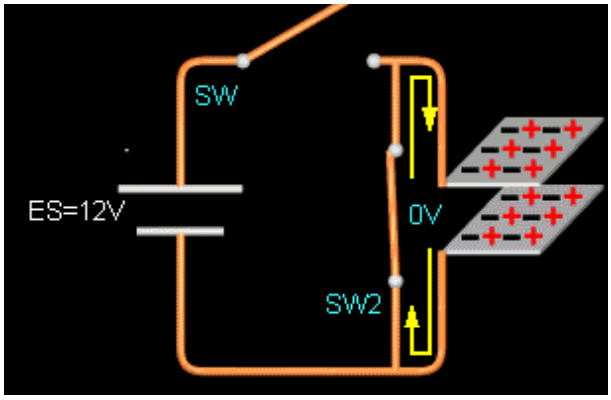


ABRINDO A CHAVE

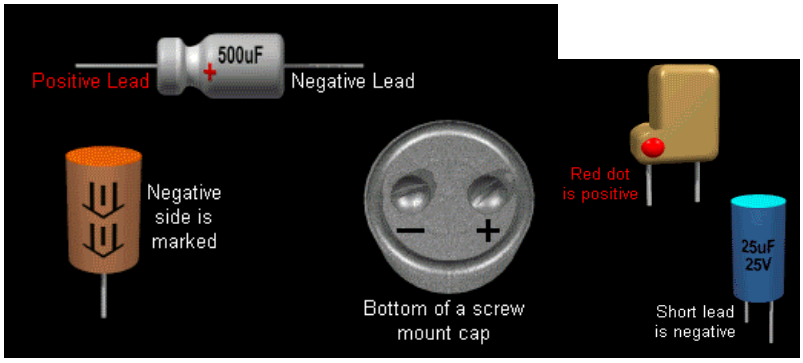


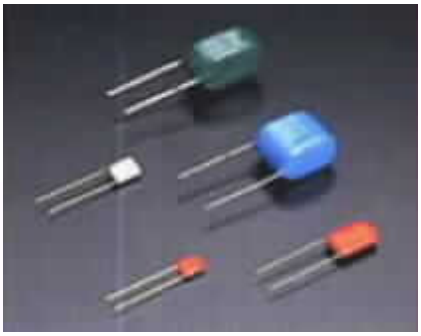
DESCARREGANDO CAPACITOR

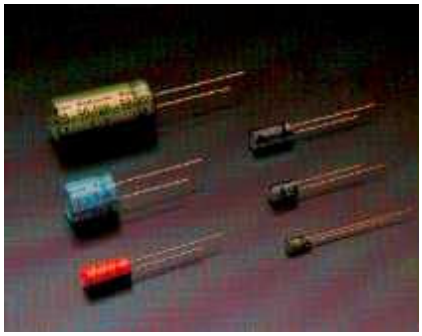


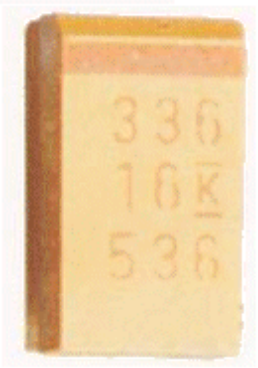


| ALGUNS CAPACITORES







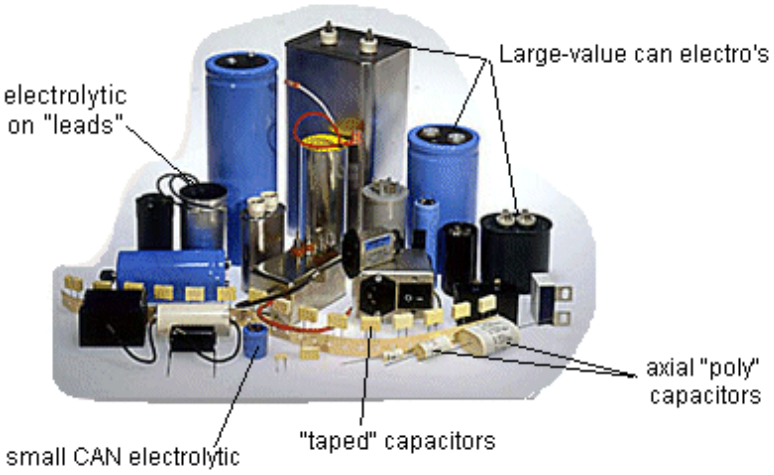


33u
chip capacitor
(close-up)

chip capacitor
(close-up)

"poly" capacitor

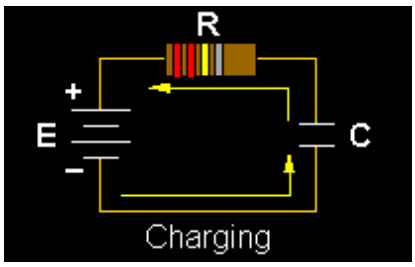
tantalum
capacitor

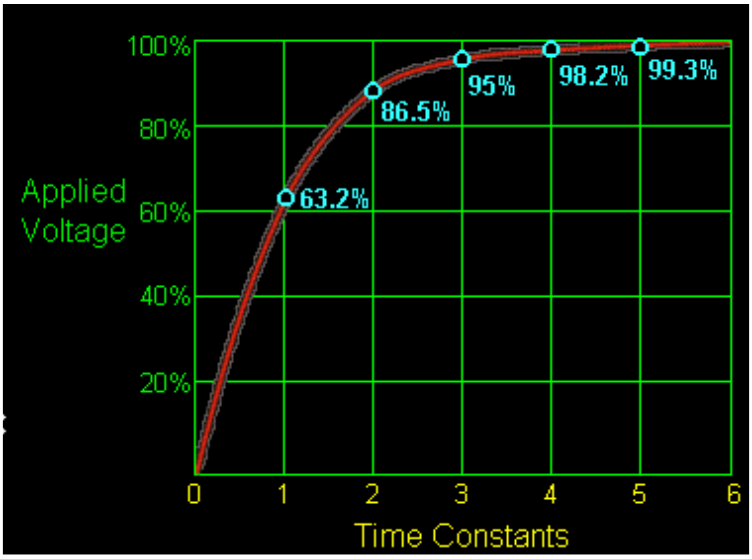


CIRCUITO DE TEMPO COM CAPACITOR

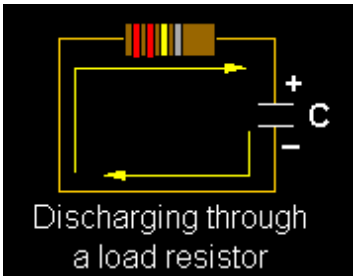
T=RC

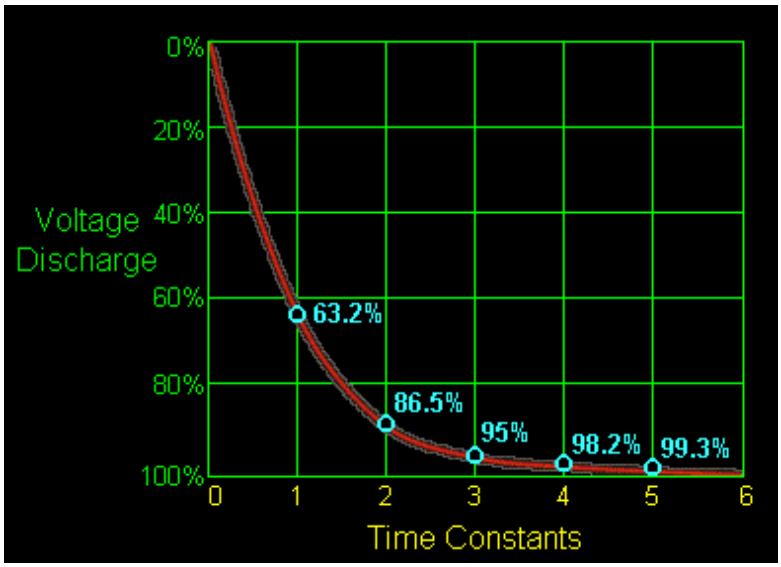
CARGA



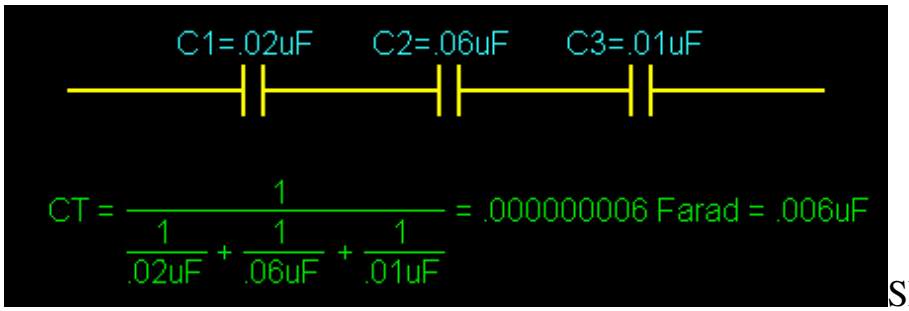


DESCARGA





ASSOCIAÇÃO DE CAPACITORES
SÉRIE

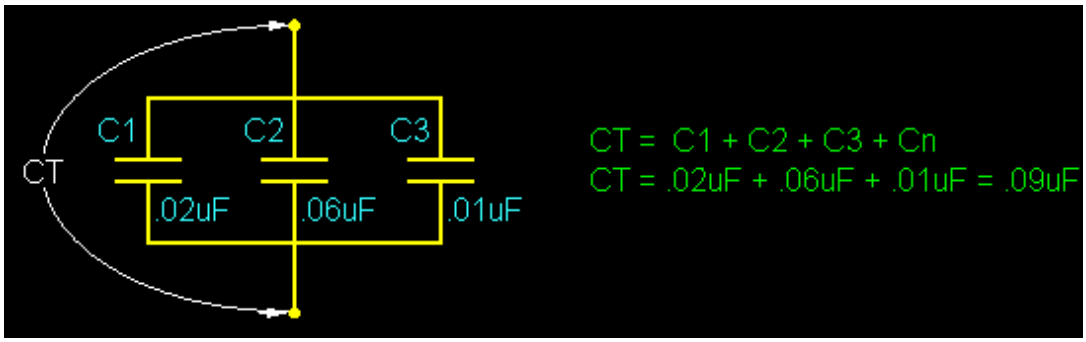


SÉRIE

- **CAPACITORES EM SÉRIE SE DIVIDEM (CONTRÁRIO DA ASSOCIAÇÃO DE RESISTORES)**

$$C_{total} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \dots \frac{1}{C_N}}$$

PARALELO



- **CAPACITORES EM PARALELO SE SOMAM (CONTRÁRIO DA ASSOCIAÇÃO DE RESISTORES)**

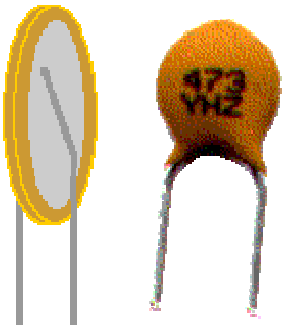
Ctotal =C1+C2+....CN

ALGUNS TIPOS DE CAPACITORES

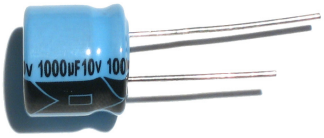
1. ceramico - 1p to 100n
2. poliester - 1n to 1u
3. electrolítico - 1u to 100,000u

LENDO CAPACITORES

PODE-SE LER OS CAPACITORES ATRAVÉS DE NÚMEROS OU CORES.



= 47000pF ou 47nF

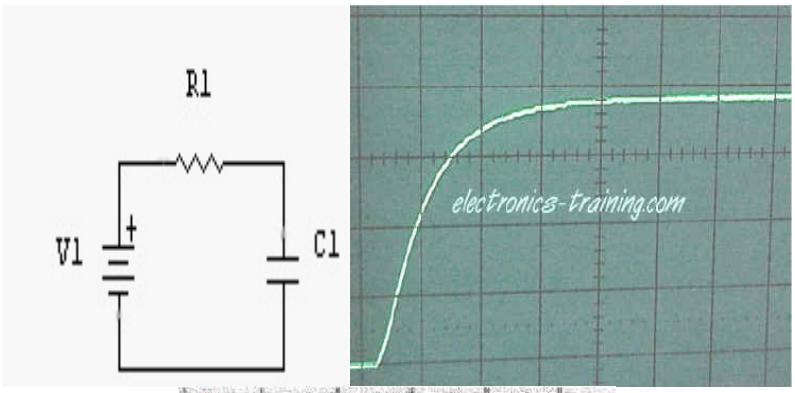


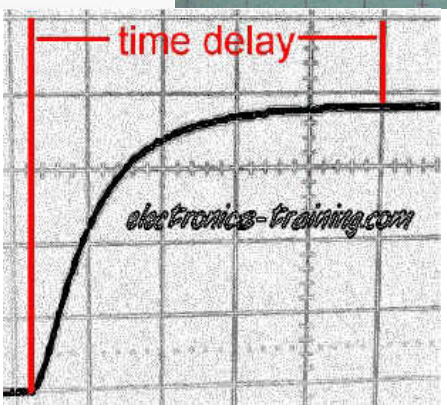
=1000uf

VALORES DE CAPACITORES NO MERCADO

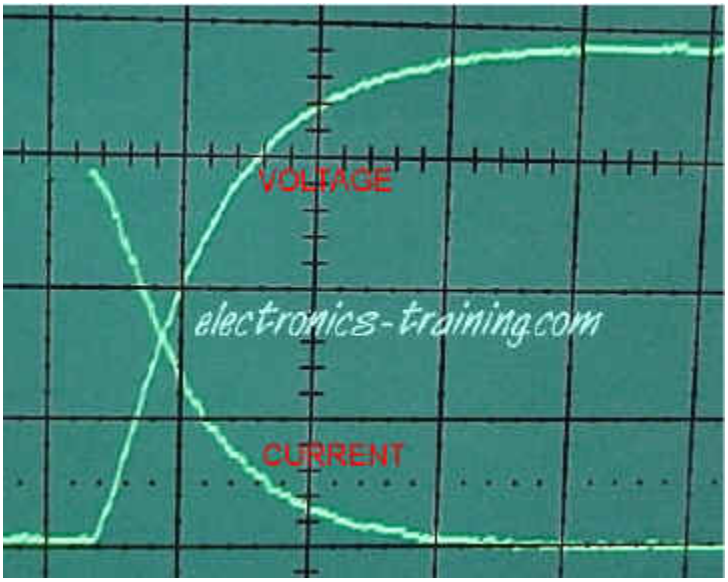
COMPLETE RANGE OF CAPACITORS:	TYPE OF CAPACITOR:
1p0, 1p2, 1p5, 1p8, 2p2, 2p7, 3p3, 3p9, 4p7, 5p6, 6p8, 8p2, 10p, 12p, 15p, 18p, 22p, 27p, 33p, 39p, 47p, 56p, 68p, 82p, 100p, 120p, 150p, 180p, 220p, 270p, 330p, 390p, 470p, 560p, 680p, 820p,	**Ceramic**
1000p (1n), 1n2, 1n5, 1n8, 2n2, 2n7, 3n3, 3n9, 4n7, 5n6, 6n8, 8n2, 10n, 12n, 15n, 18n, 22n, 27n, 33n, 39n, 47n, 56n, 68n, 82n, 100n, 220n 330n 470n,	**ceramic and greencap**
1u, 2u2, 3u3, 4u7, 10u, 22u, 47u, 100u, 220u, 470u, 1,000u, 2200u, 4700u, 10,000u.	**Electrolytic**

TENSÃO E CORRENTE NO CAPACITOR

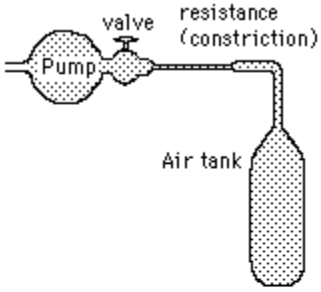




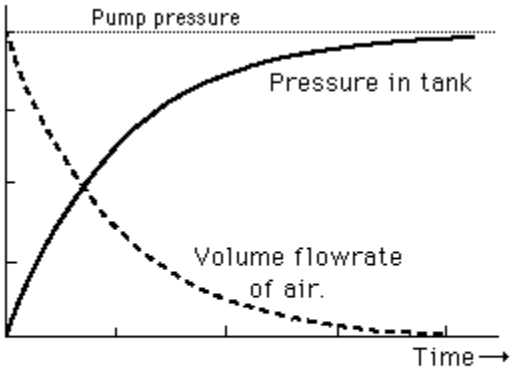
A RELAÇÃO TENSÃO X CORRENTE



ANALOGIA COM TANQUE DE GAS



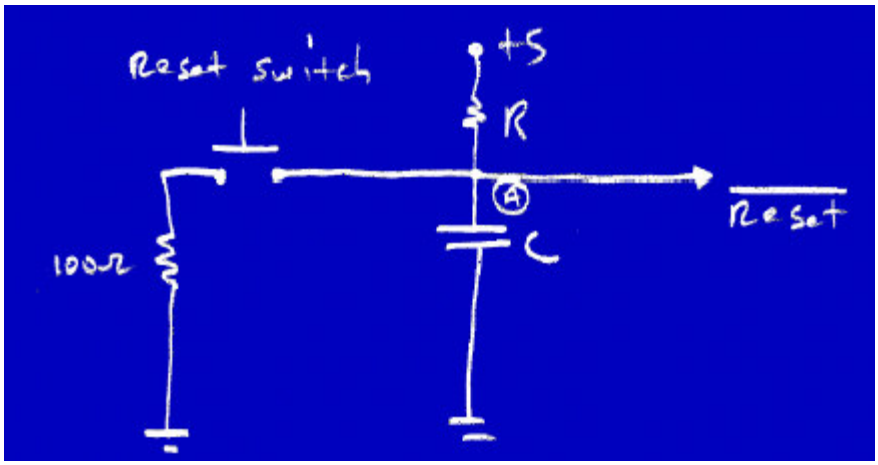
As pumping continues, volume flowrate decreases as pressure in tank builds up. When tank pressure equals pressure supplied by the pump, the flow ceases.



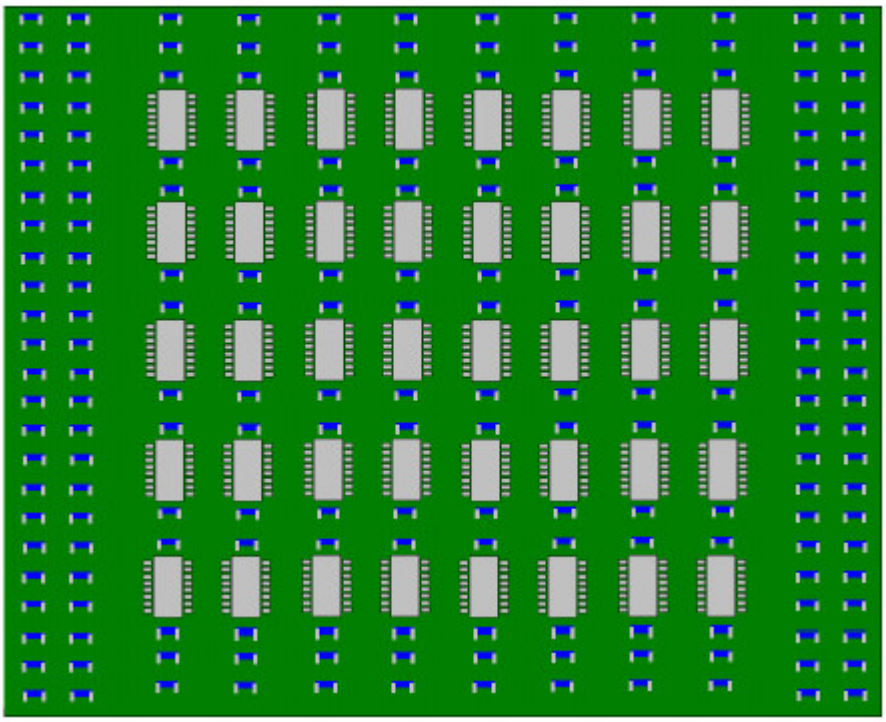
If you have more constriction in the tubing leading to the tank, it will take longer to fill the tank.

APLICAÇÕES CAPACITOR

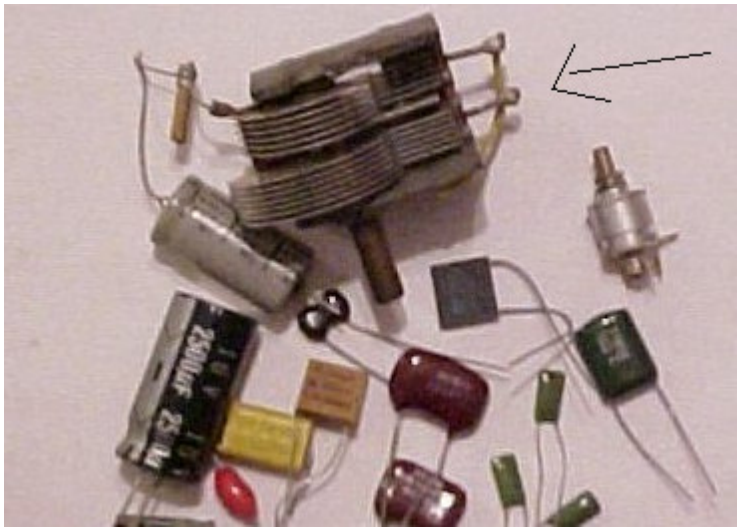
CIRCUITO DE RESET COM CAPACITOR



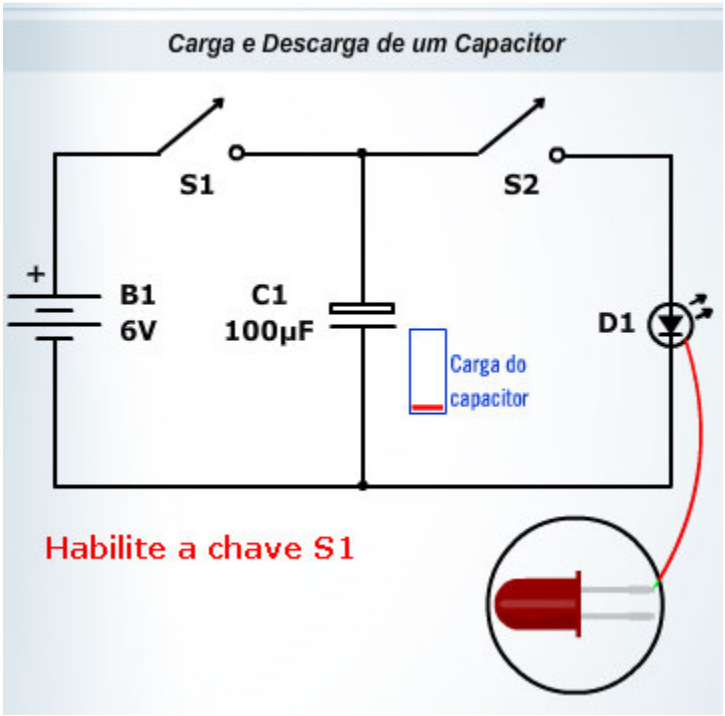
FILTRO



RÁDIO ANTIGO



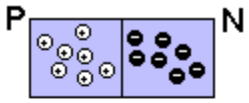
CIRCUITO BÁSICO DE FLASH COM CAPACITOR



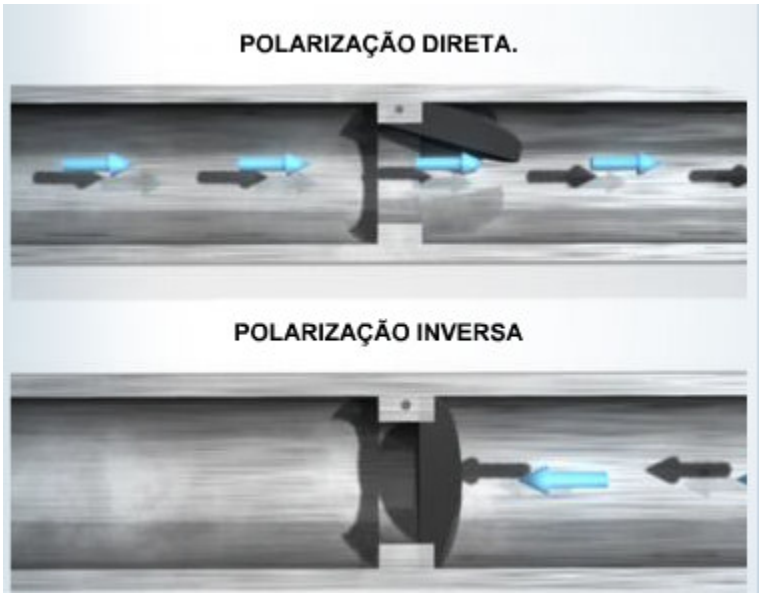
RESUMO

- CAPACITORES PODEM ARMAZENAR ENERGIA
- CAPACITOR NAO CONSOMEM ENERGIA
- CURTO CIRCUITANDO CAPACITORES DESCARREGAR O MESMO
- COMPRIMENTO, DISTANCIA E SOLUÇÃO ELETROLÍTICA INFLUENCIAM NA CAPACITANCIA
- A UNIDADE DE CAPACITÂNCIA É FARADAY(F)
- A MAIORIA DOS CAPACITORES ESTÃO EM uF ou pF
- A DESCARGA DE UM CAPACITOR FARÁ COM QUE AS PLACAS TENHAM O MESMO NÚMERO DE CARGAS

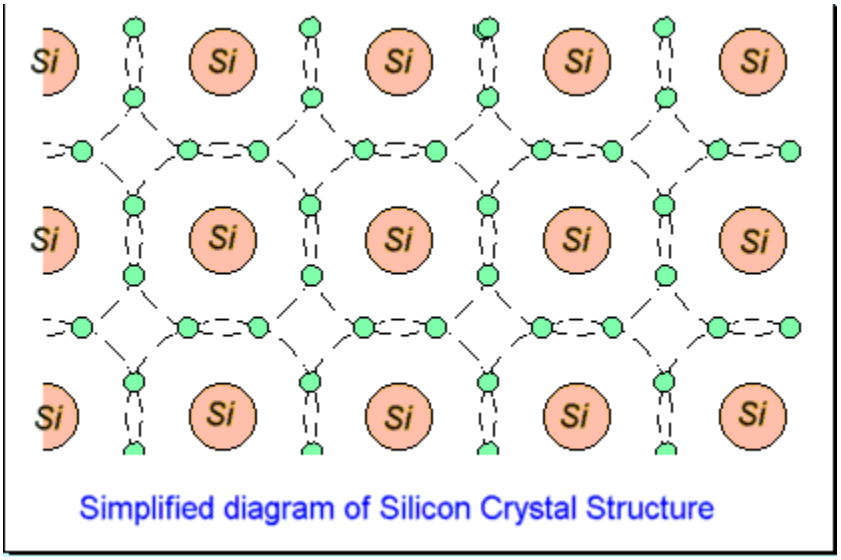
DIODOS



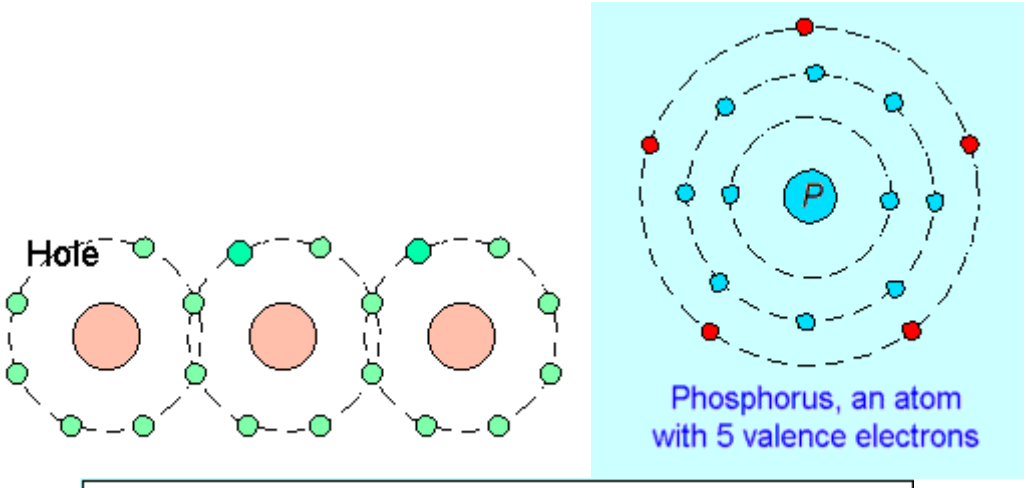
SÓ DEIXA CONDUZIR NUM SENTIDO

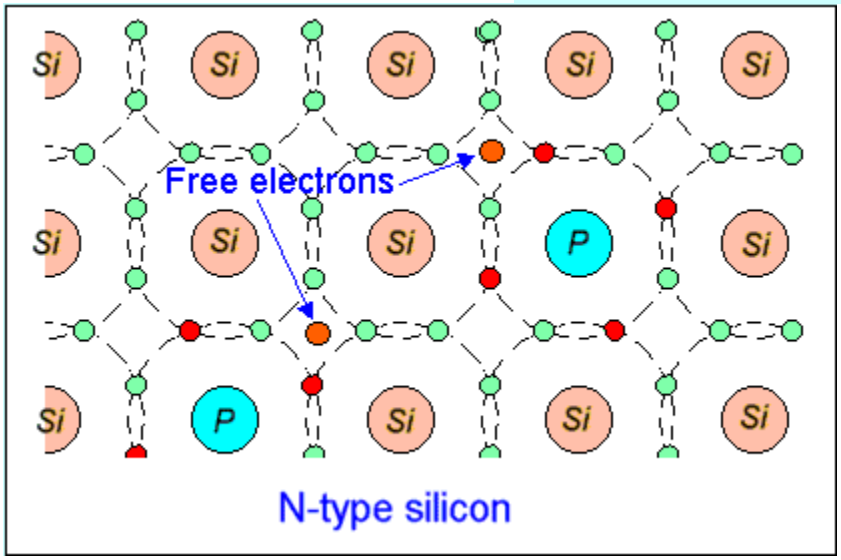


SILÍCIO

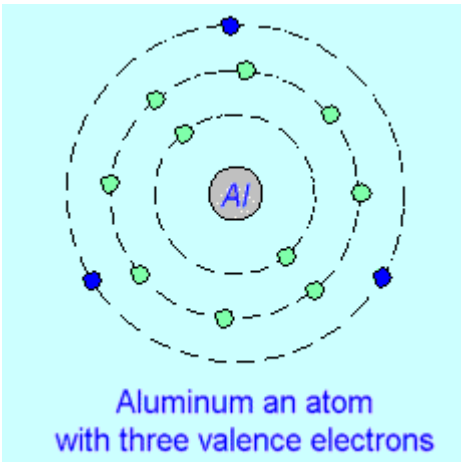


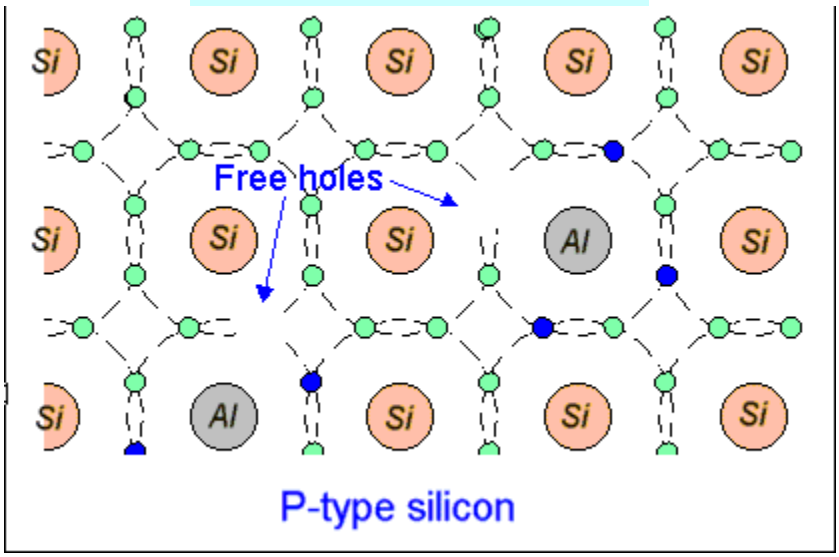
FÓSFORO



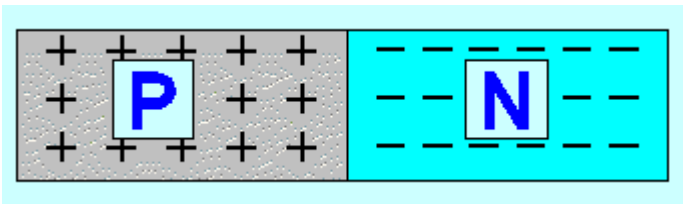


ALUMÍNIO

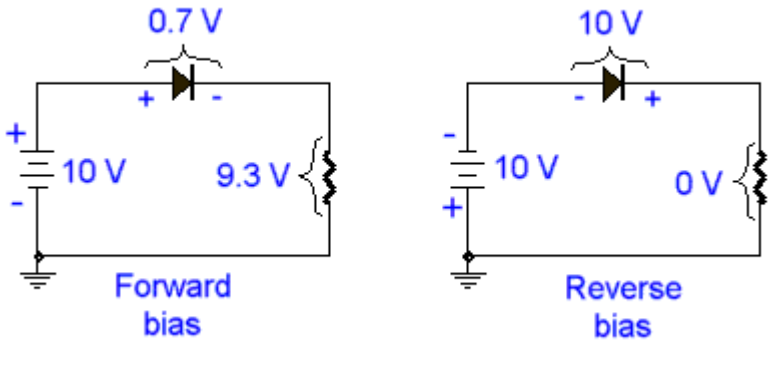




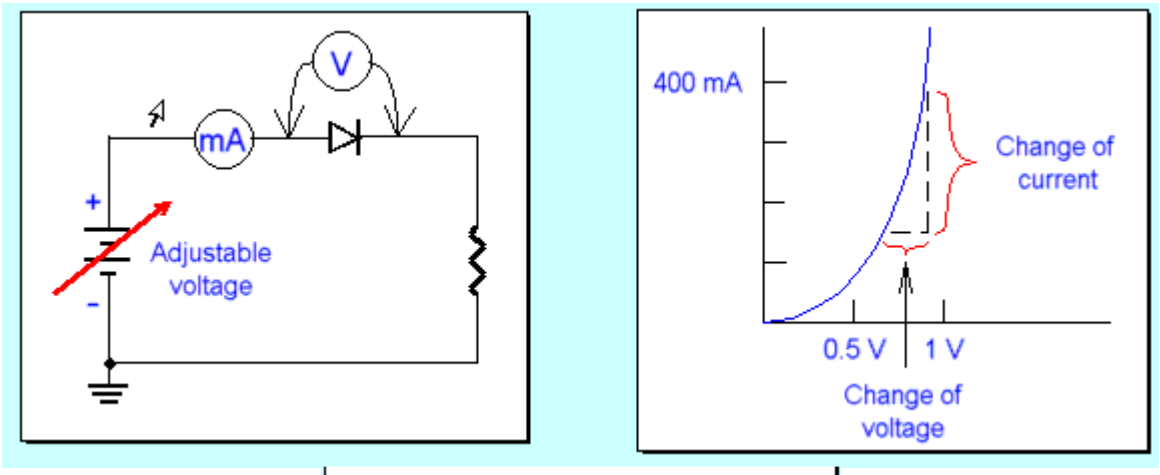
DOPAGEM

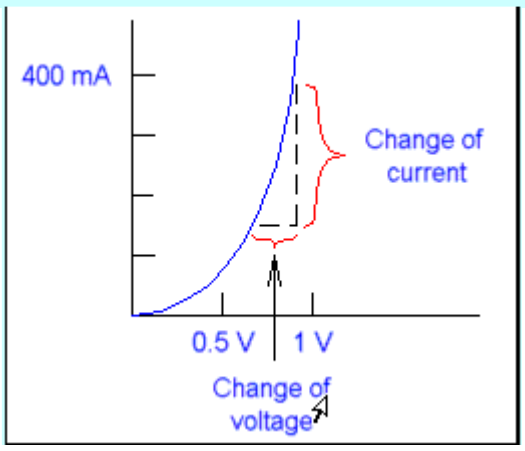


QUEDA DE TENSÃO DO DIODO

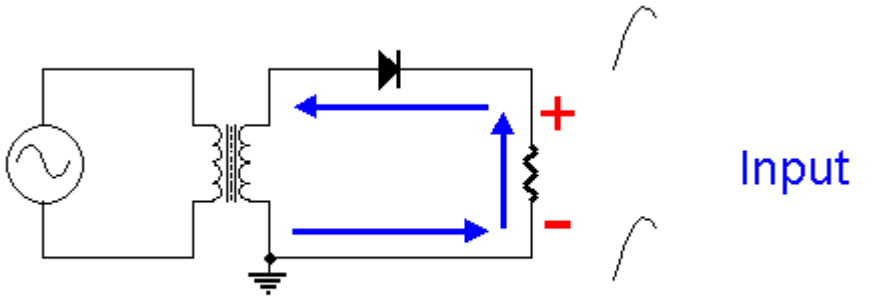


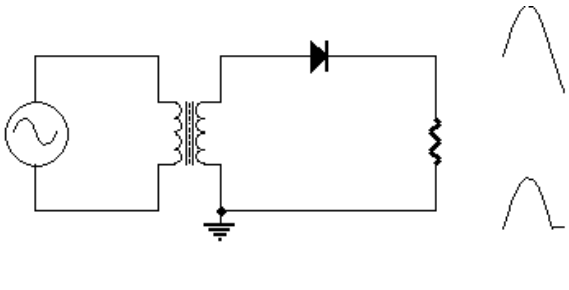
CURVA DO DIODO

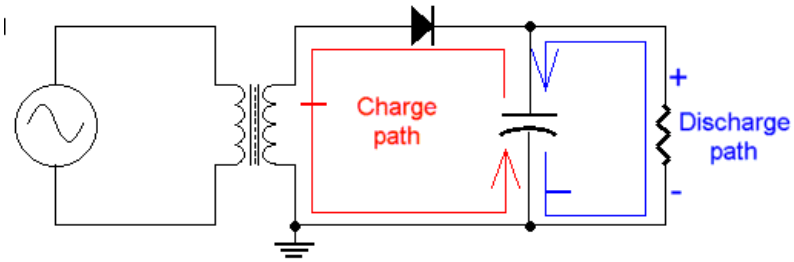


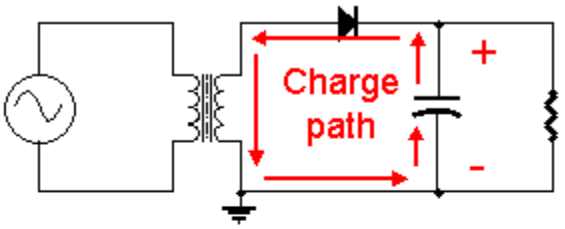


DIODO NA FONTE DE UM PC

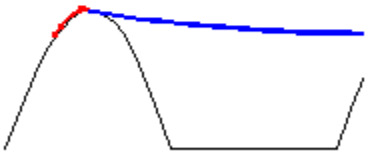


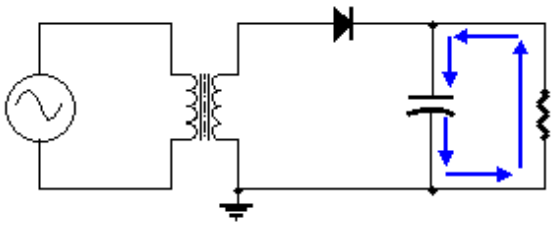




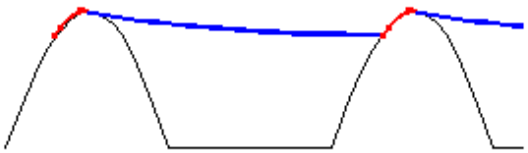


The colored line shows the voltage across the load.

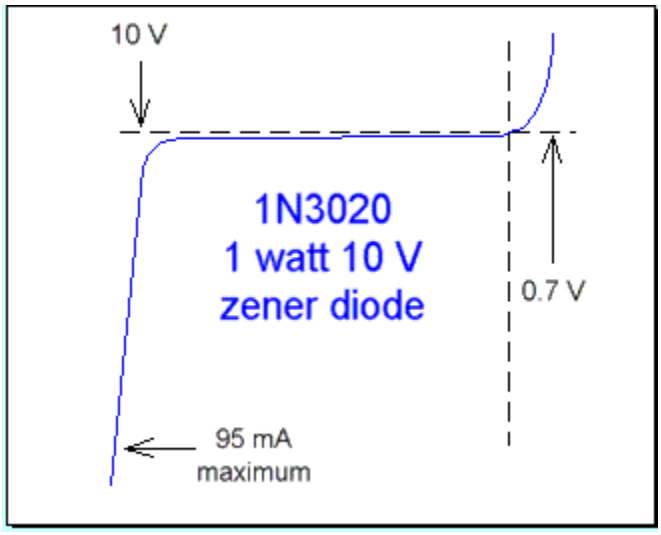




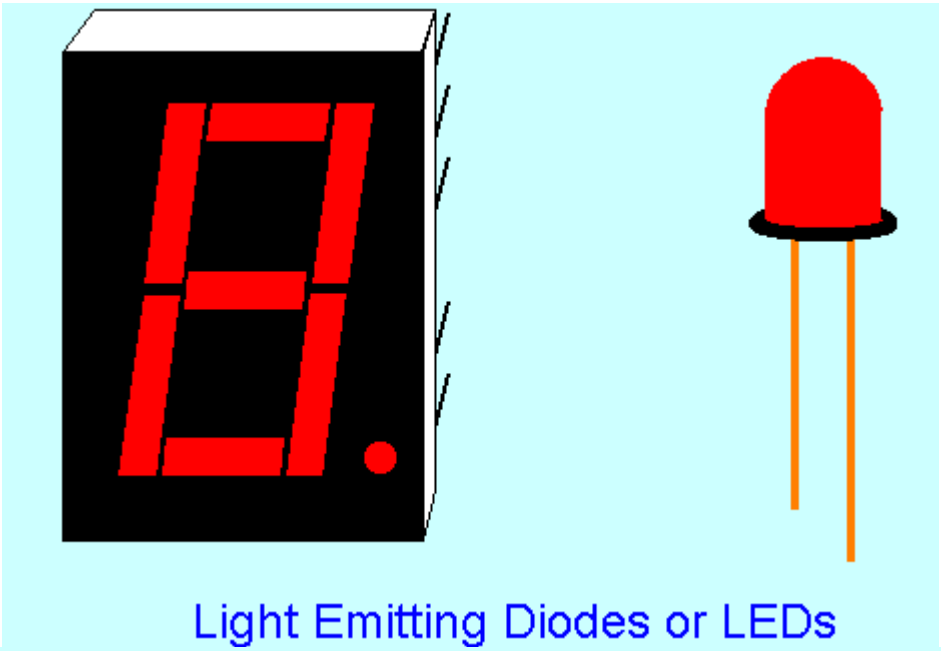
The colored line shows the voltage across the load.

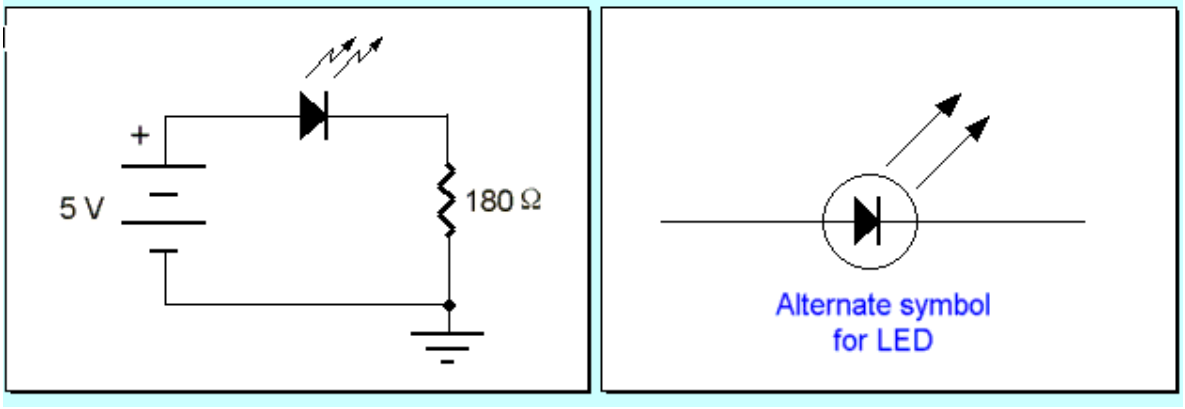


DIODO ZENER

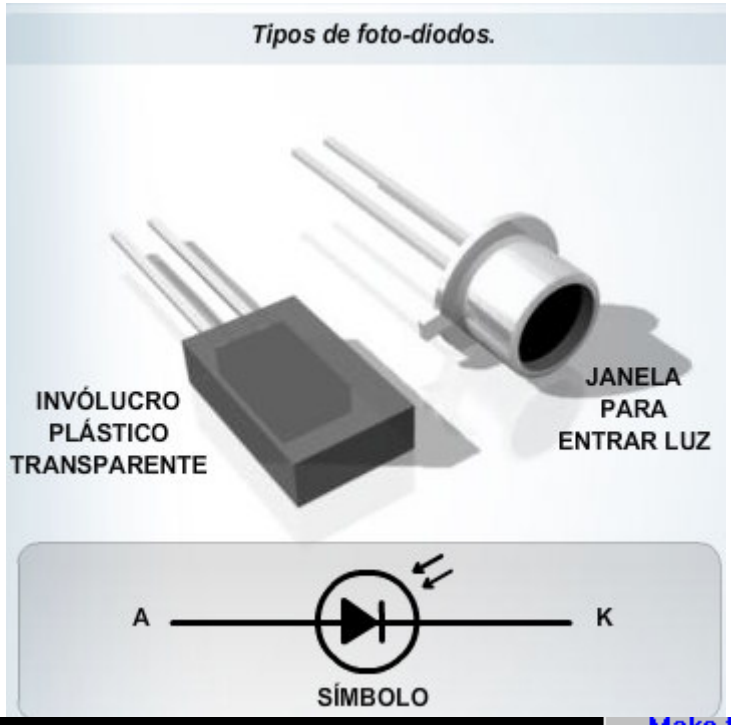


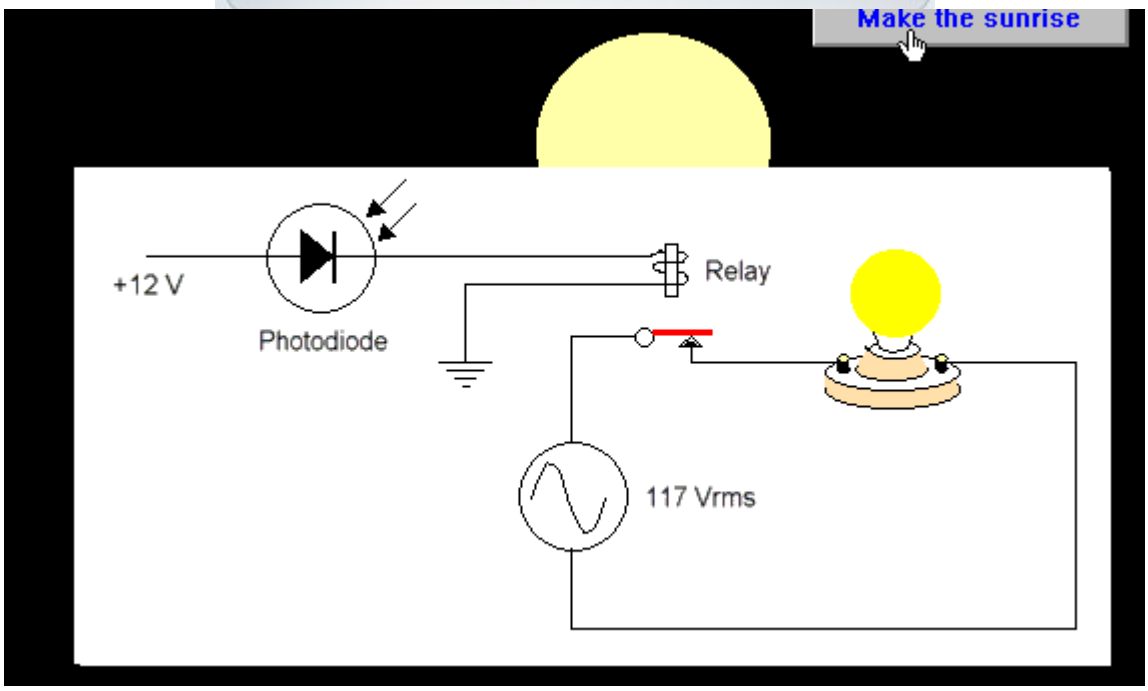
LEDS

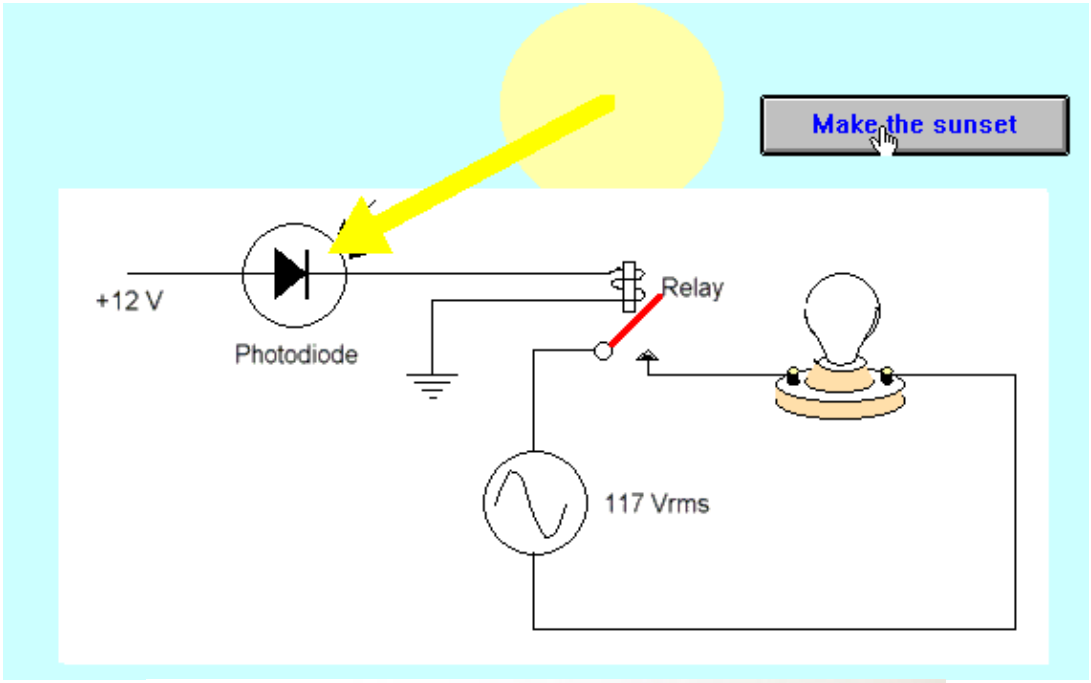


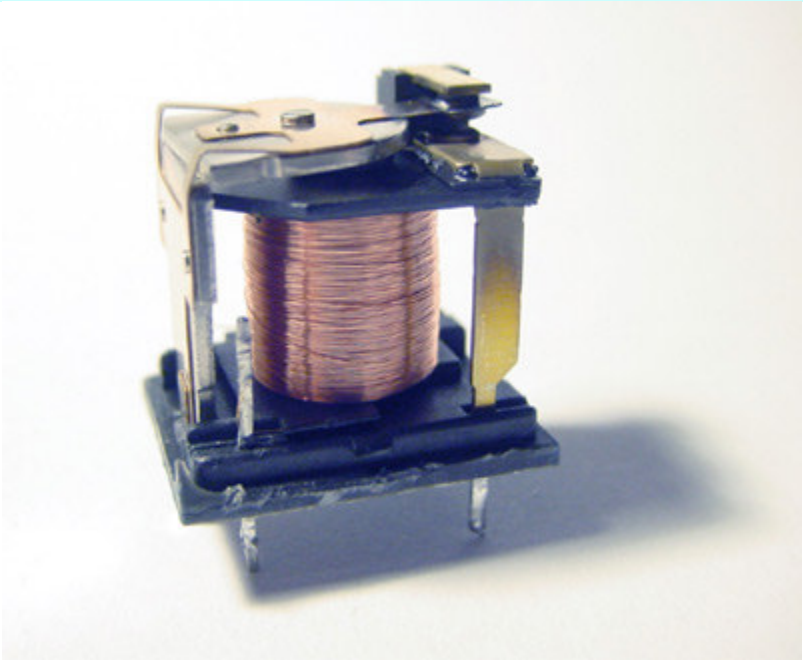


FOTODIODOS

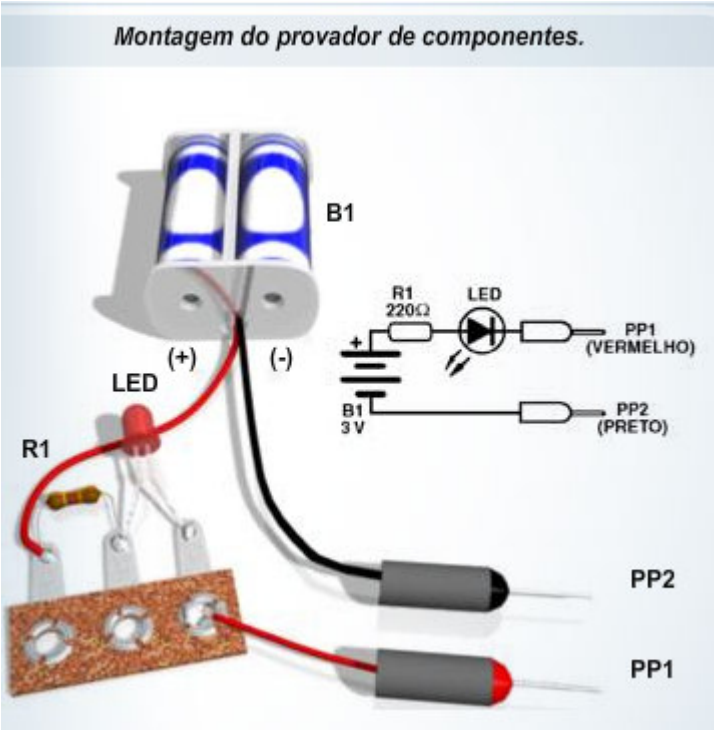

Tipos de foto-diodos.
INVÓLUCRO
PLÁSTICO
TRANSPARENTE
JANELA
PARA
ENTRAR LUZ
A
K
SÍMBOLO


Make the sunrise
+12 V
Photodiode
Relay
117 Vrms

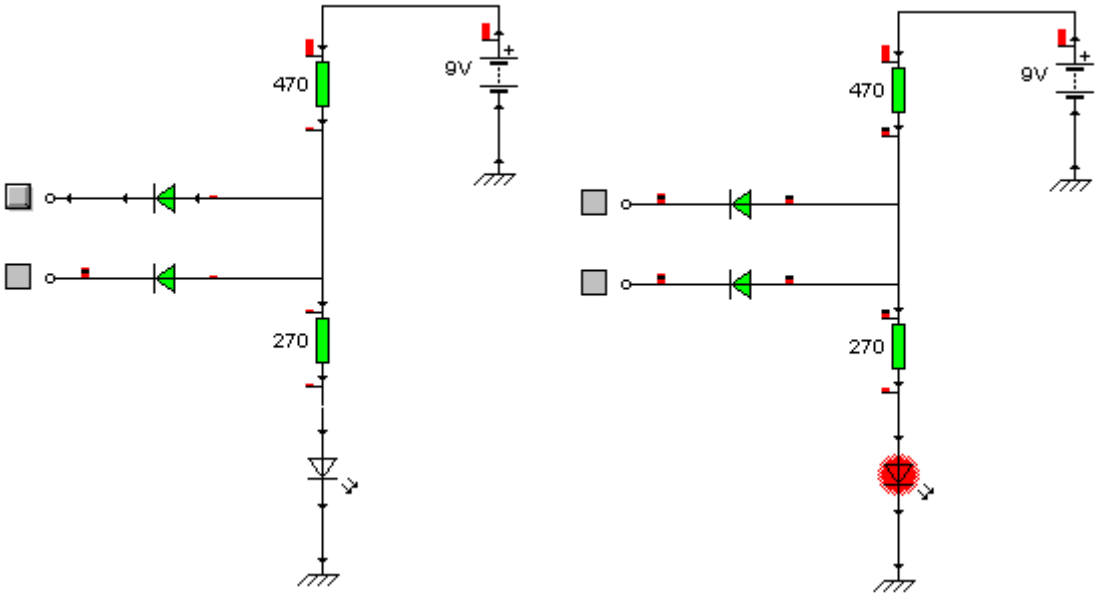

Make the sunset
+12 V
Photodiode
Relay
117 Vrms



TESTADOR DE DIODOS

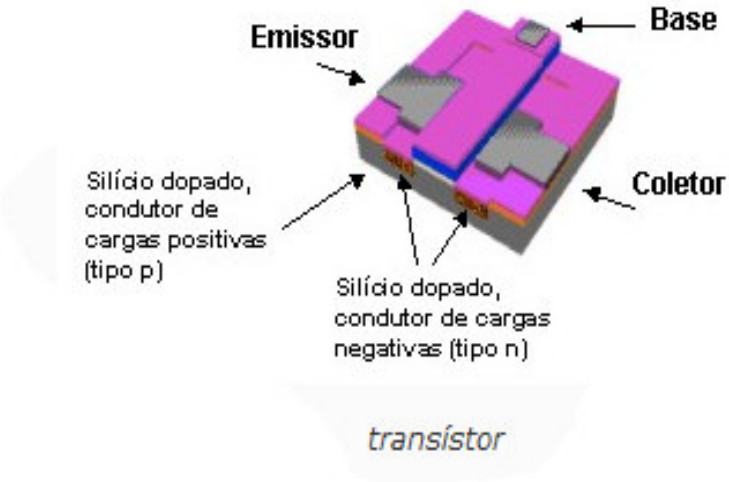


PORTAS LOGICAS (E)

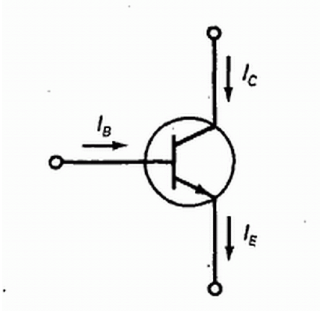


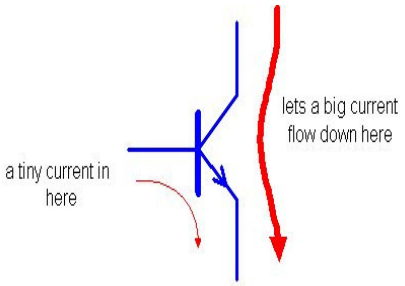
TRANSISTORES

OS TRANSISTORES SÃO FORMADOS BASICAMENTE POR TRÊS PARTES:
COLETOR (POLO NEGATIVO)
BASE (CONTROLA O ESTADO DO TRANSISTOR)
EMISSOR (POLO POSITIVO).
NORMALMENTE É CONSTITUÍDO DE **SILÍCIO**, MAS PODE SER FORMADO POR OUTROS MATERIAIS COMO O **GERMÂNIO**.



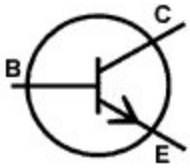
OS TRANSISTORES FUNCIONAM COMO UM INTERRUPTOR.



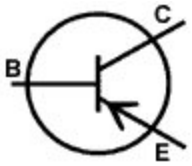


DEPENDENDO DO TIPO, APLICANDO-SE CORRENTE NA BASE, PODE SER ABERTO OU FECHADO O CIRCUITO.

SIMBOLOGIA



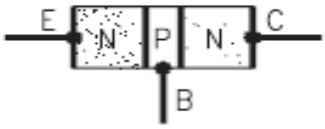
NPN

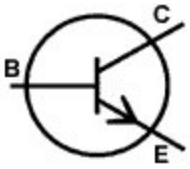


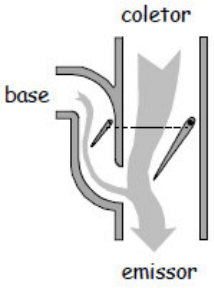
PNP

B – Base
C – Coletor
E – Emissor

TRANSITOR NPN

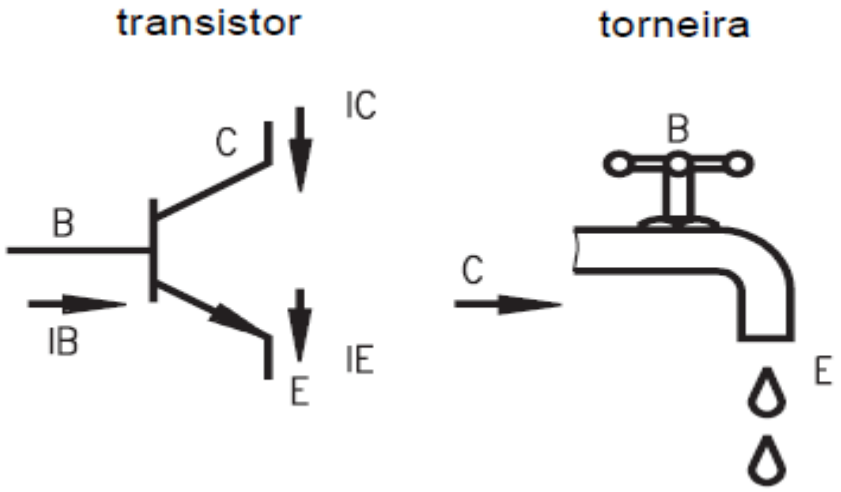




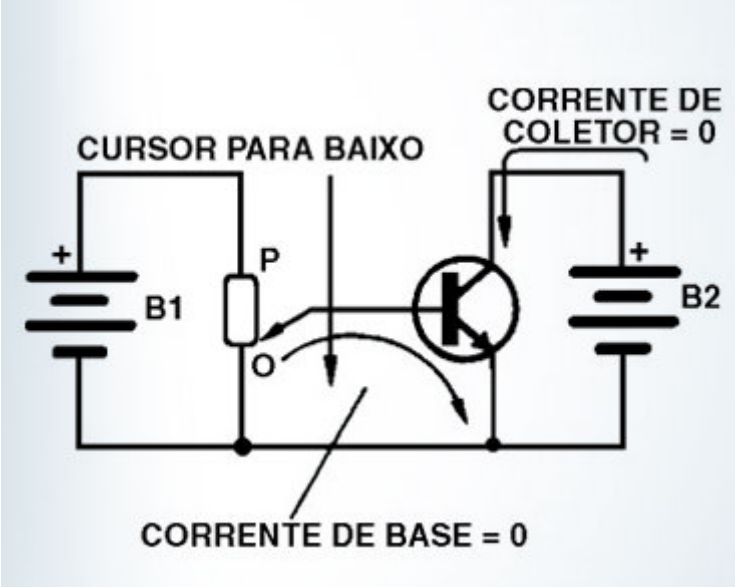


NPN

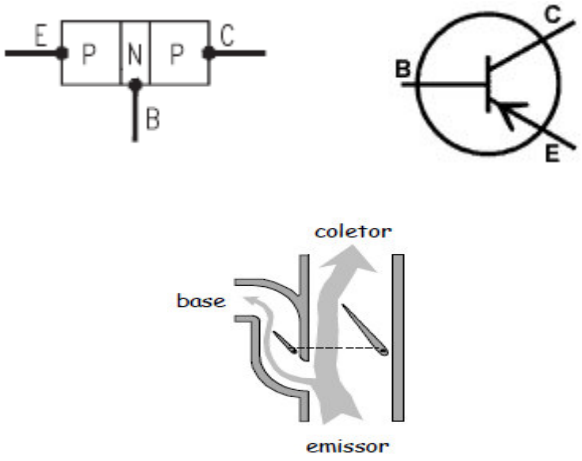
QUANDO SE APLICA UMA CORRENTE NA BASE, O CIRCUITO É FECHADO, EXISTINDO ASSIM UMA CORRENTE ENTRE O COLETOR E O EMISSOR. LOGO, QUANDO O TRANSISTOR NÃO ESTÁ LIGADO, NÃO EXISTE CARGA NA BASE E ASSIM NÃO EXISTE CORRENTE ENTRE O COLETOR E EMISSOR.



O TRANSISTOR NPN TEM SUA CONFIGURAÇÃO PARECIDO A UMA TORNEIRA. NA TORNEIRA O CONTROLE DE ABERTURA DO REGISTRO FAZ VARIAR O FLUXO DE ÁGUA E NO TRANSISTOR A CORRENTE APLICADA NA BASE CONTROLA A CORRENTE ENTRE O COLETOR E O EMISSOR.

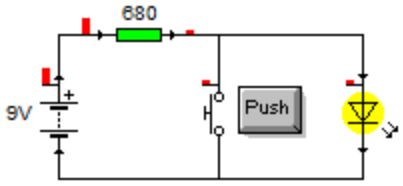


TRANSISTOR PNP

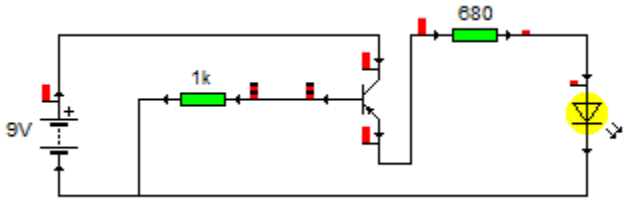


NO TRANSISTOR PNP, EXISTE CORRENTE QUANDO É APLICADO UM SINAL NEGATIVO NA BASE E ESTA CORRENTE É NO SENTIDO EMISSOR-COLETOR. SE TIVER TENSÃO POSITIVA NA BASE, NÃO HÁ CORRENTE NO CIRCUITO.

ESTE TIPO DE TRANSISTOR FUNCIONA COMO UMA CHAVE INVERTIDA, QUE QUANDO ESTÁ PRESSIONADA NÃO DEIXA PASSAR CORRENTE E QUANDO NÃO ESTÁ PRESSIONADA DEIXA PASSAR CORRENTE. ESTE EXEMPLO ESTÁ REPRESENTADO NO CIRCUITO ABAIXO:

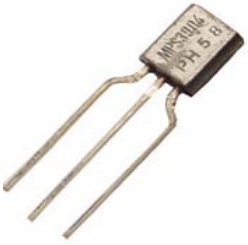


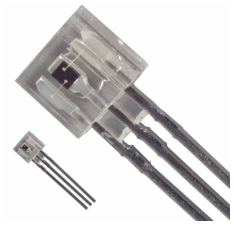
CIRCUITO DE CHAVE INVERTIDA

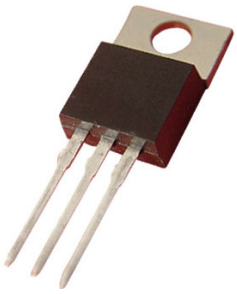


CIRCUITO COM TRANSISTOR PNP REPRESENTANDO
O FUNCIONAMENTO DE UMA CHAVE INVERTIDA

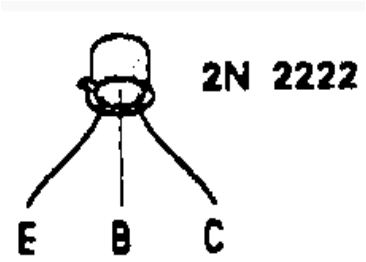
TIPOS DE TRANSISTORES

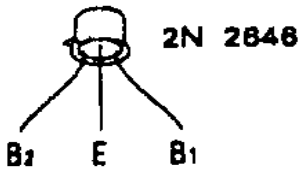


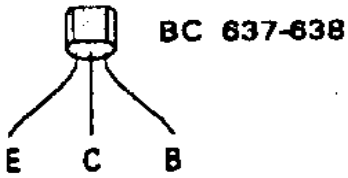


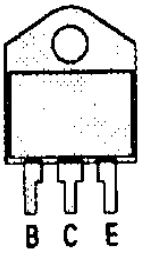


Fototransistor

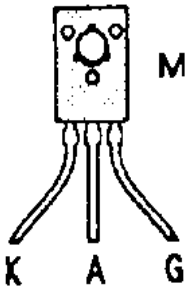




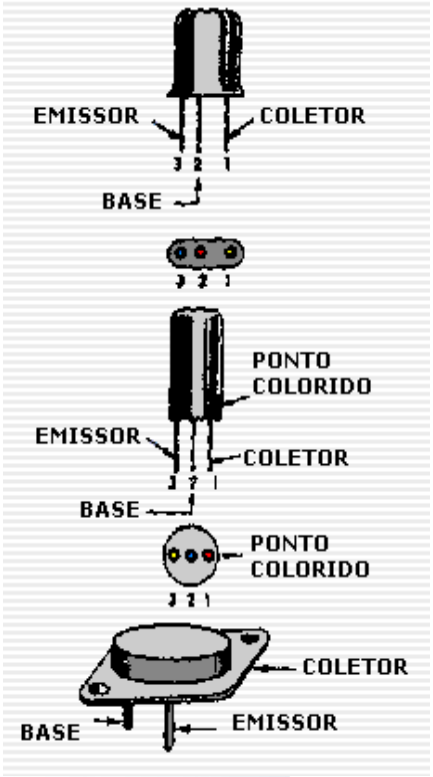


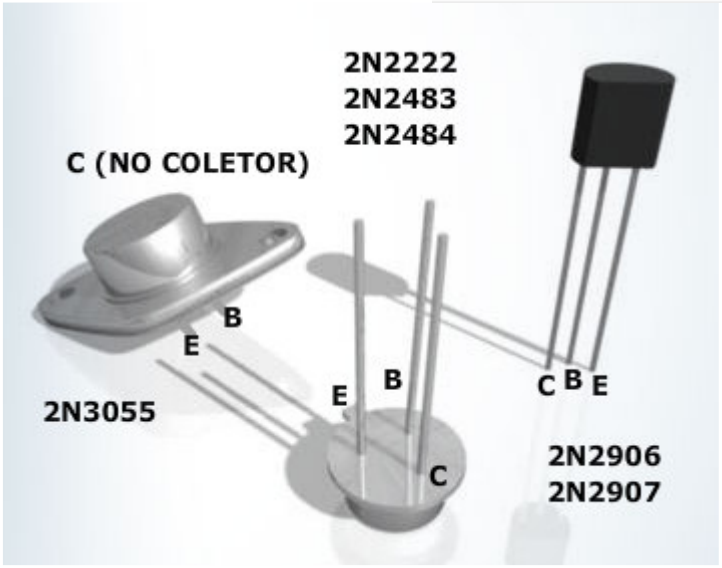


TIP 33-34
TIP 140-142
TIP 145-147
TIP 3055



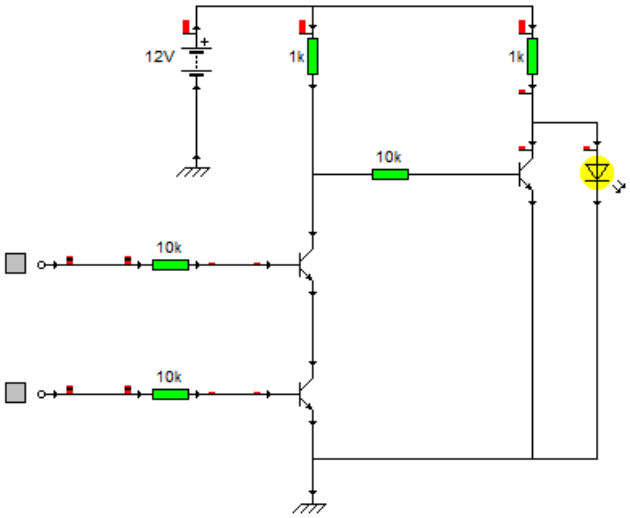
MCR 106



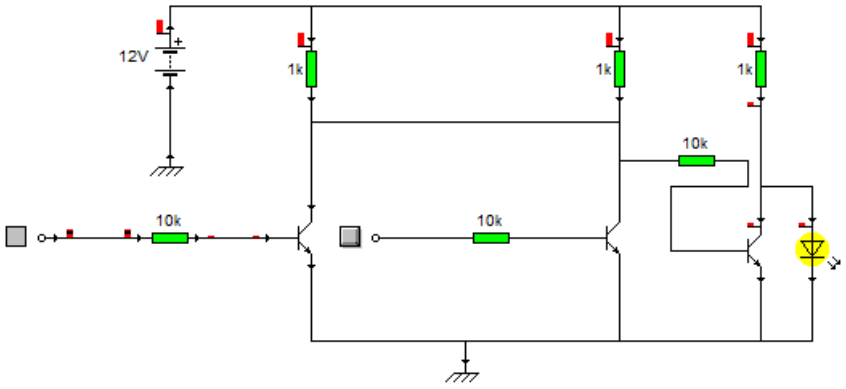


TRANSISTORES COMO PORTA-LÓGICA

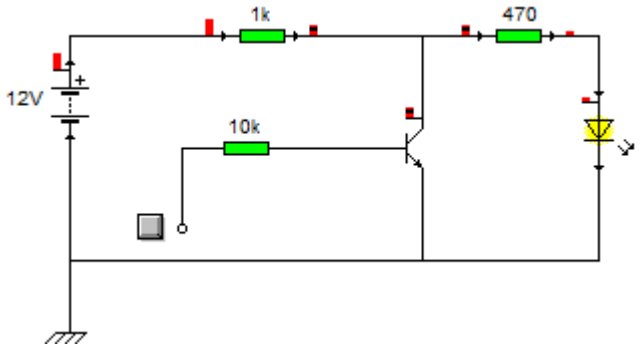
PORTA AND



PORTA OR

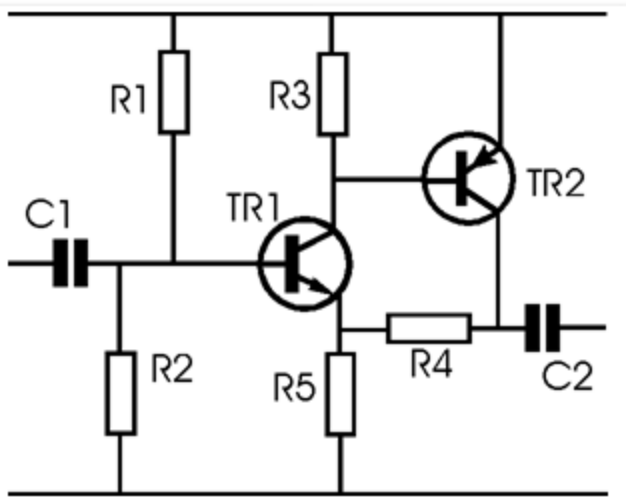


PORTA NOT



APLICAÇÕES UTILIZANDO TRANSISTOR

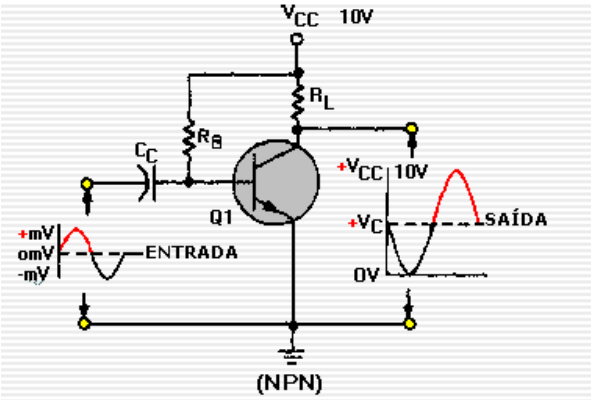
CIRCUITO AMPLIFICADOR:



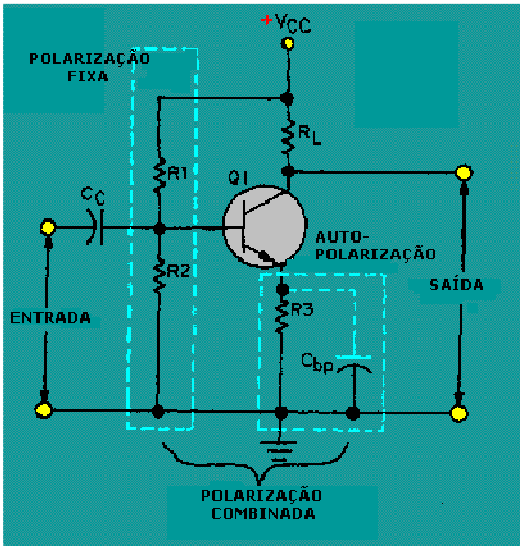
Two transistor amplifier circuit with feedback

$$Av = (R4 + R5) / R4$$

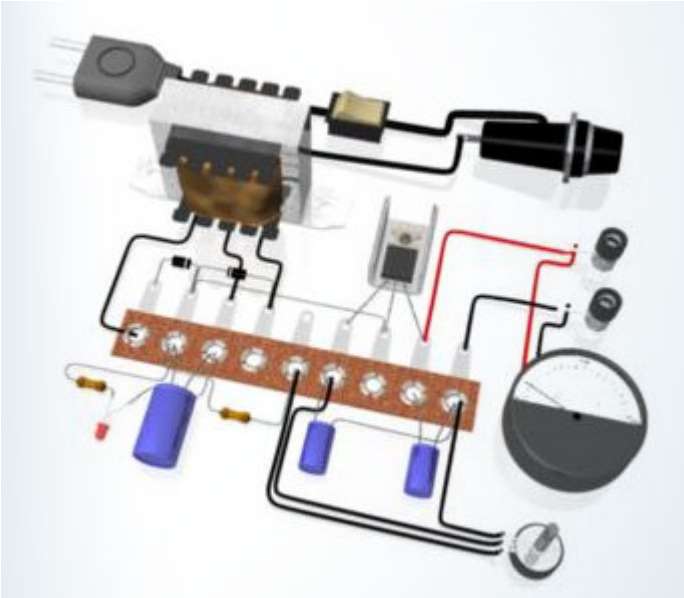
CIRCUITO DE ENTRADA-SAÍDA:



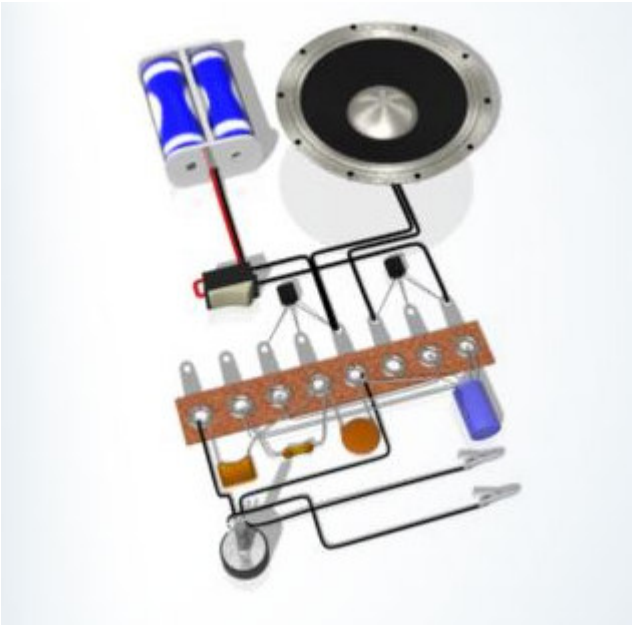
CIRCUITO DE POLARIZAÇÃO FIXA:



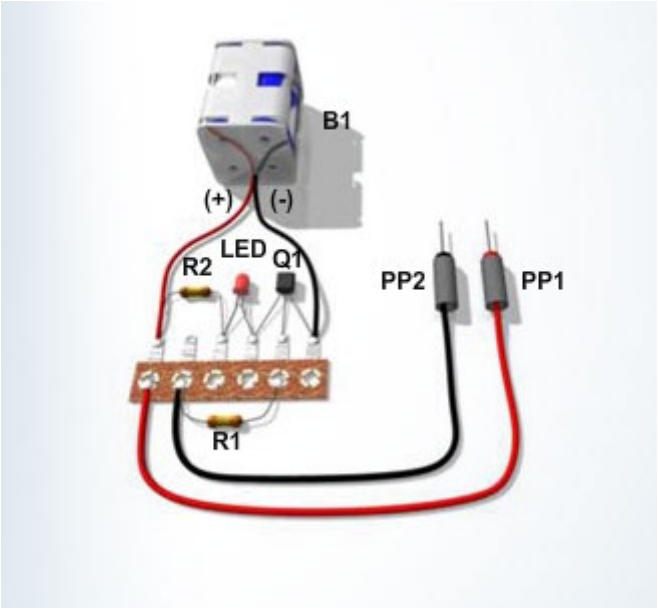
- AMPLICADOR DE TENSÃO
- MINI FONTE



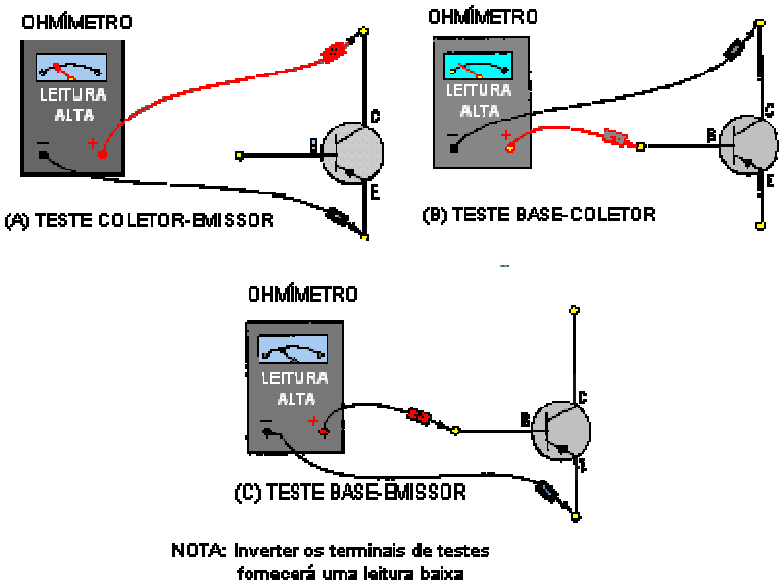
- AMPLICADOR DE POTÊNCIA



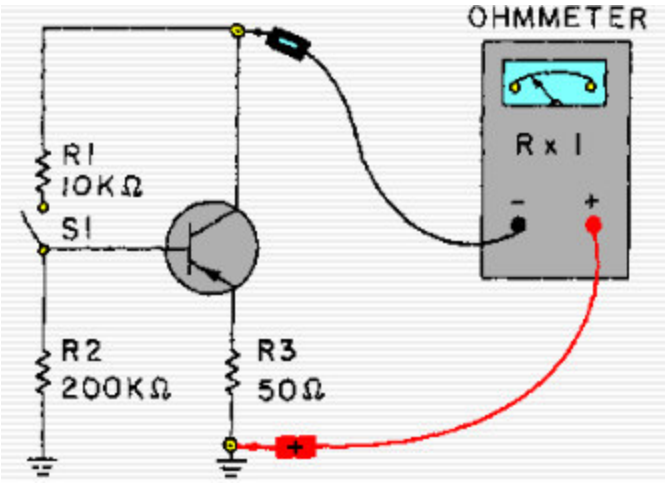
- OSCILADOR DE RÁDIO FREQUÊNCIA
- CASADOR DE IMPEDÂNCIA
- CHAVEADOR (LIGA-DESLIGA)


B1
(+)
(-)
R2
LED
Q1
PP2
PP1
R1

MEDINDO TRANSISTORES COM OHMÍMETRO



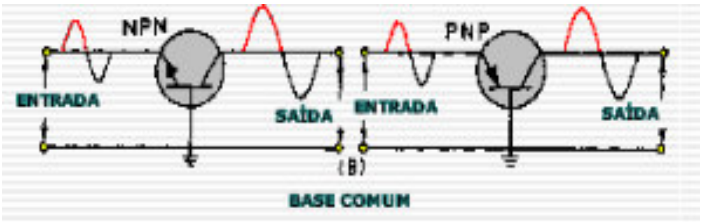
ENQUANTO A JUNÇÃO BASE-EMISSOR NÃO ESTIVER POLARIZADA, HAVERÁ POUCA OU NENHUMA CORRENTE ENTRE EMISSOR E COLETOR.



CONFIGURAÇÕES DE TRANSISTORES

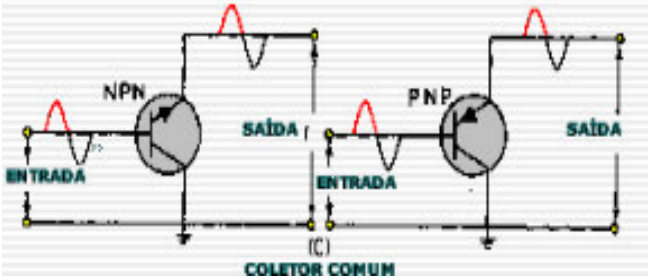
TIPO DE AMPLIFICADOR	BASE COMUM	EMISSOR COMUM	COLETOR COMUM
RELAÇÃO DE FASE DE ENTRADA/SAÍDA	0°	180°	0°
GANHO DE VOLTAGEM	ALTO	MÉDIO	BAIXO
GANHO DE CORRENTE	BAIXO(α)	MÉDIO(β)	ALTO(γ)
GANHO DE POTÊNCIA	BAIXO	ALTO	MÉDIO
RESISTÊNCIA NA ENTRADA	BAIXO	MÉDIO	ALTO
RESISTÊNCIA NA SAÍDA	ALTO	MÉDIO	BAIXO

BASE COMUM (CB)



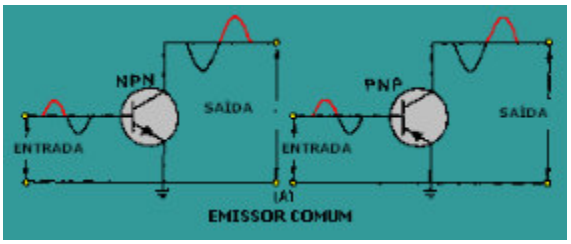
UTILIZADA PARA CASAMENTO DE IMPEDÂNCIA.
BAIXA RESISTÊNCIA NE ENTRADA E ALTA NA SAÍDA.
GANHO DE CORRENTE < 1
EMISSOR = ENTRADA
COLETOR = SAÍDA

COLETOR COMUM (CC)



CONTROLADOR DE CORRENTE PARA CASAMENTO DE IMPEDÂNCIA.
UTILIZADA NO CHAVEAMENTO DE CIRCUITOS.
CONHECIDO COMO SEGUIDOR-DE-EMISSOR.
ALTA IMPEDÂNCIA NA ENTRADA E BAIXA NA SAÍDA.
BASE = ENTRADA
EMISSOR = SAÍDA

EMISSOR COMUM (CE)



UTILIZADO PARA CIRCUITOS DE AMPLIFICADORES.
GANHOS DE POTÊNCIA, VOLTAGEM E CORRENTE.
OFERECE REVERSÃO DE FASE ENTRE OS SINAIS DE ENTRADA E SAÍDA.
BASE-EMISSOR = ENTRADA
COLETOR-EMISSOR = SAÍDA

GANHO DO TRANSISTOR

$$\alpha = \frac{\Delta I_C}{\Delta I_E} \qquad \beta = \frac{\Delta I_C}{\Delta I_B} \qquad \gamma = \frac{\Delta I_E}{\Delta I_B}$$

CAPACIDADE DE AMPLICAÇÃO DE UM AMPLICADOR.
RAZÃO DA SAÍDA PARA A ENTRADA.
APHA (α) => CB
BETA (β) => CE
GAMA (γ) => CC