

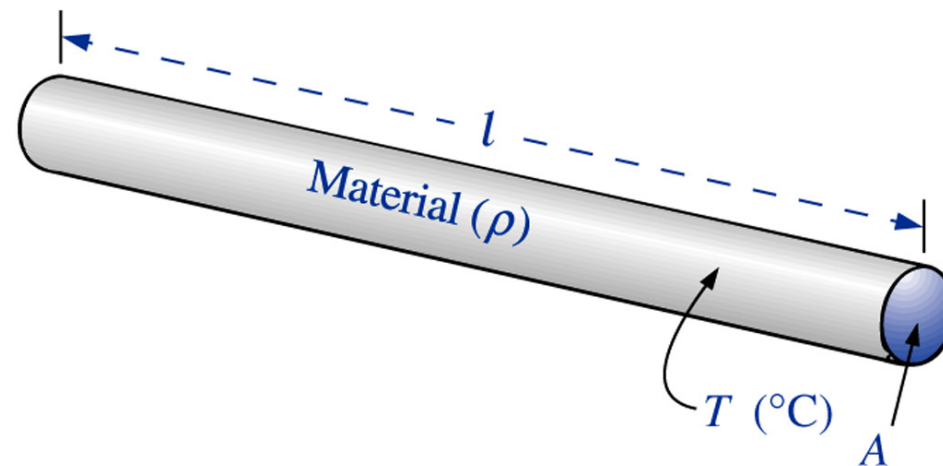
Parte A

Resistores

Resistores

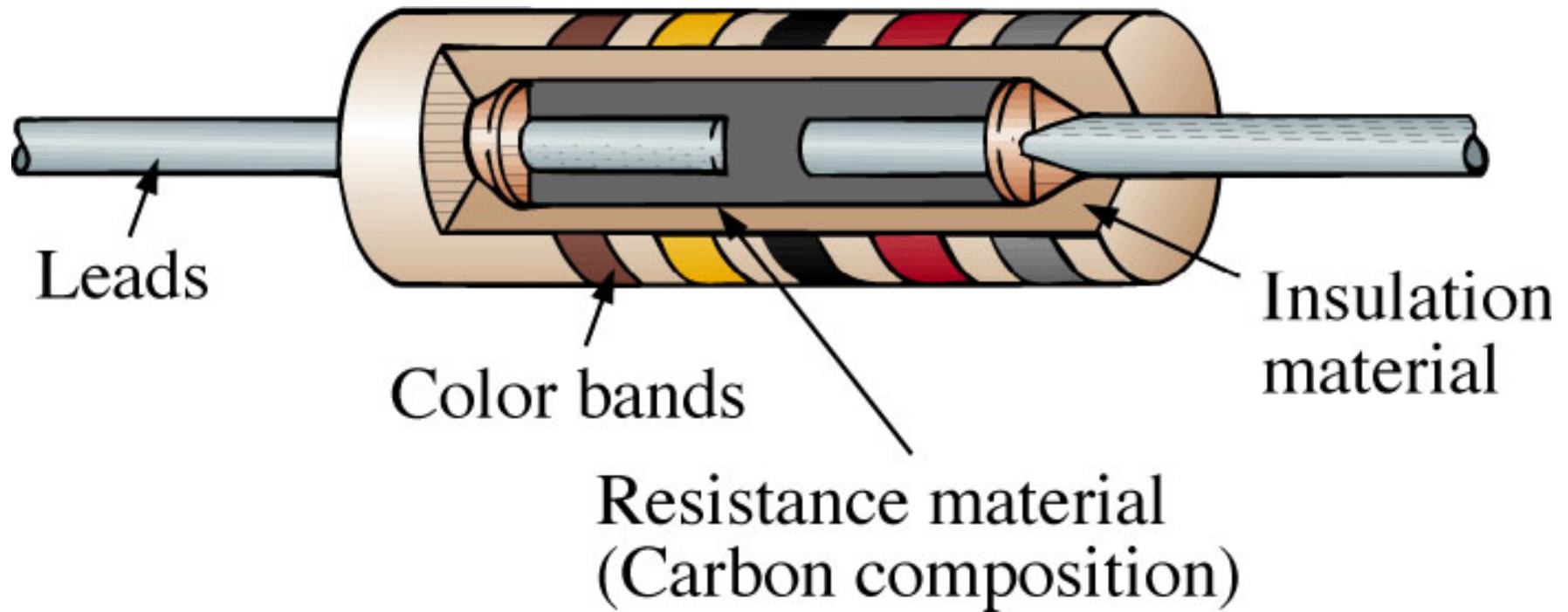
Resistência depende de:

- Material;
- Comprimento;
- Área da seção reta;
- Temperatura.



Resistores

Tipos de resistores:

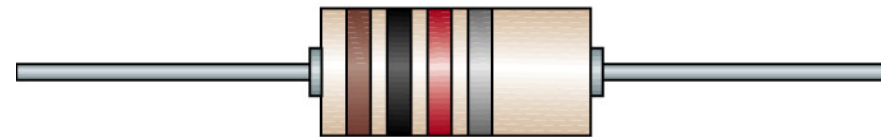


Resistor fixo de carbono.

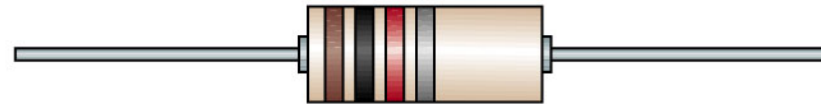
Resistores

Tipos de resistores:

Resistores fixos de carbono com potências diferentes.



2 W



1 W



$\frac{1}{2}$ W



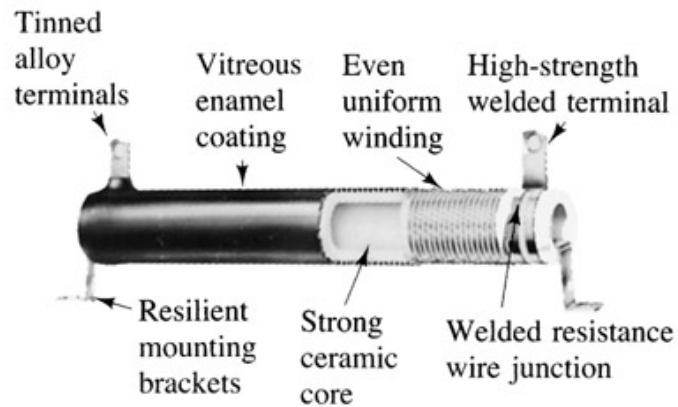
$\frac{1}{4}$ W



$\frac{1}{8}$ W

Resistores

Tipos de resistores:



(a) Vitreous-enameled wire-wound resistor
App: All types of equipment



(b) High-voltage cermet film resistors (on a high grade ceramic body).
App: For high-voltage applications up to 10 kV requiring high levels of stability.



(c) Metal-film precision resistors
App: Where high stability, low temperature coefficient, and low noise level desired

Resistores de potência de fio.

Resistores para altas tensões.

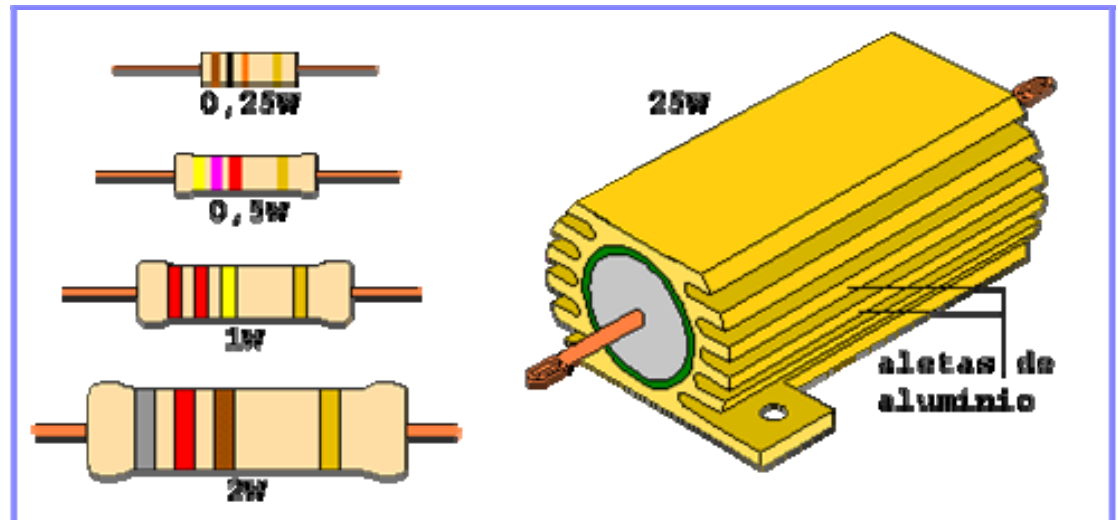
Resistores de precisão de filme metálico.

Resistores

Tipos de resistores:

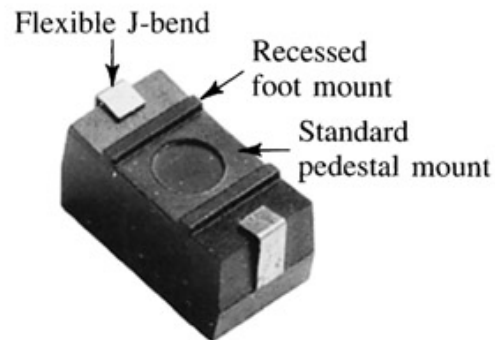


Resistores de potência.



Resistores

Tipos de resistores:



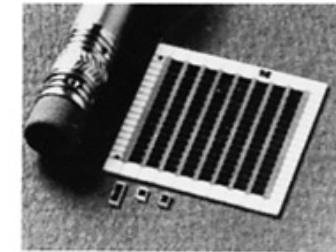
- (a) Surface mount power resistor ideal for printed circuit boards. Patented J-bends eliminate need for solder connections. (0.8 W to 3 W in wire-wound, film, or power film construction)

Resistores de potência de fio.



- (b) Precision power wire-wound resistors with ratings as high as 2 W and tolerances as low as 0.05%. Temperature coefficients as low as 20 ppm/°C are also available.

Resistores de precisão de fio.

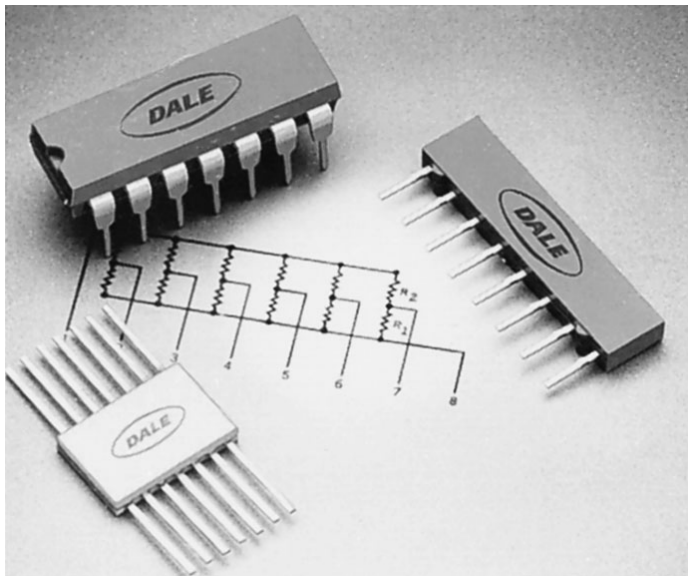


- (c) Thick-film chip resistors for design flexibility with hybrid circuitry. Pre-tinned, gold or silver electrodes available. Operating temperature range -55°C to +150°C.

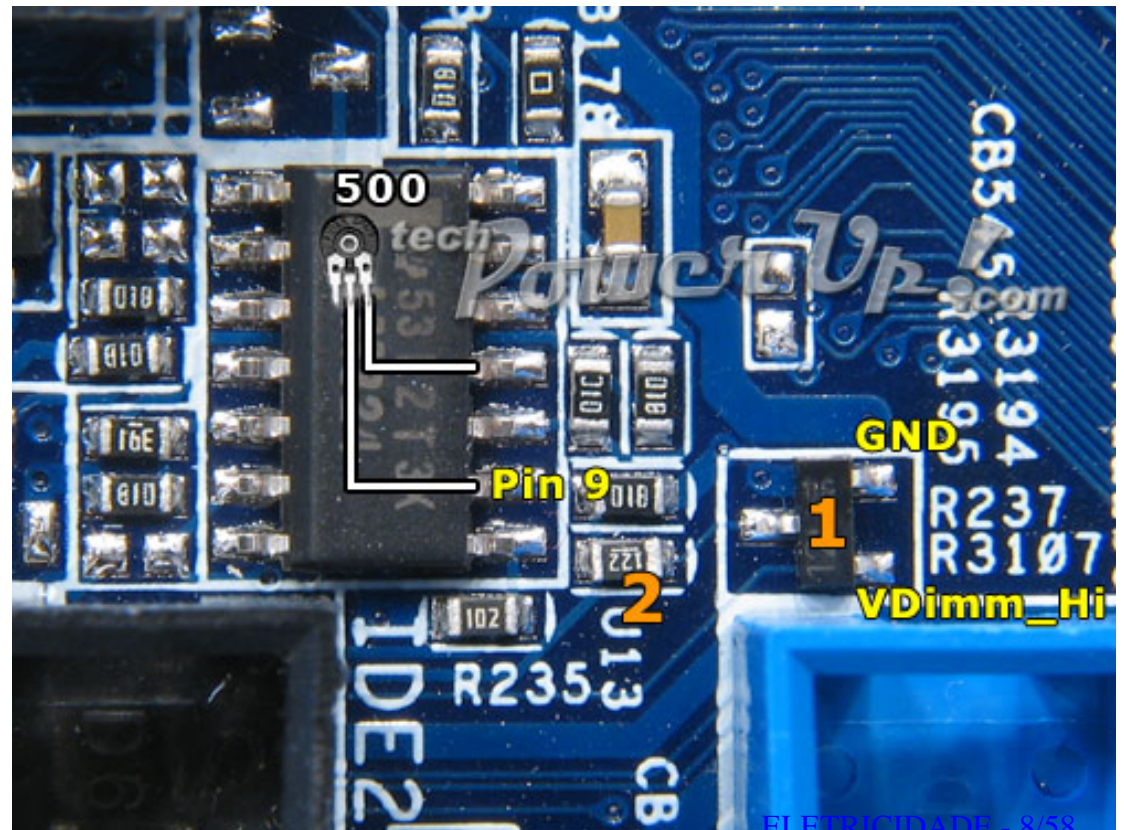
Resistores de filme em chip.

Resistores

Tipos de resistores:

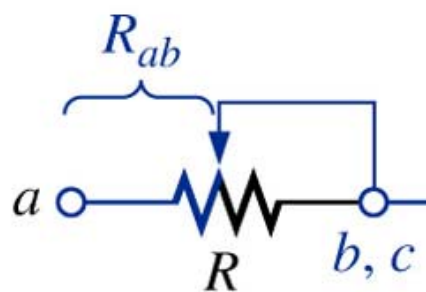
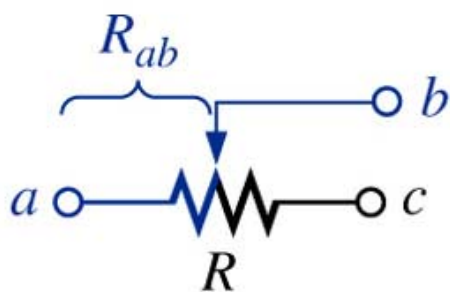
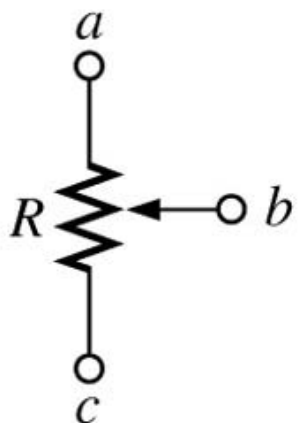


Resistores integrados e smd.



Resistores

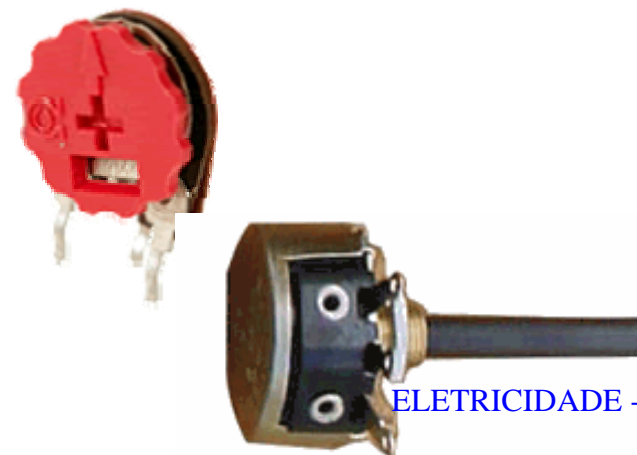
Tipos de resistores:



Resistores
variáveis e
ajustáveis.



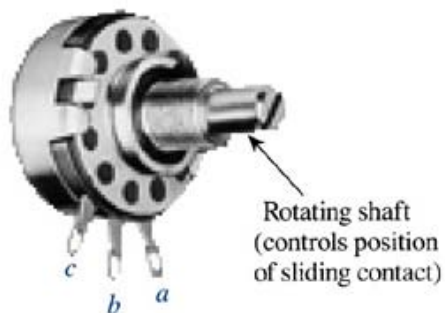
Trim pots e
potenciômetros.



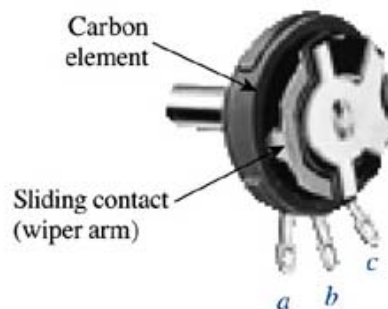
Resistores

Tipos de resistores:

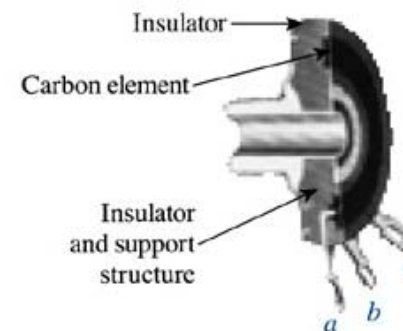
Resistores variáveis e ajustáveis.



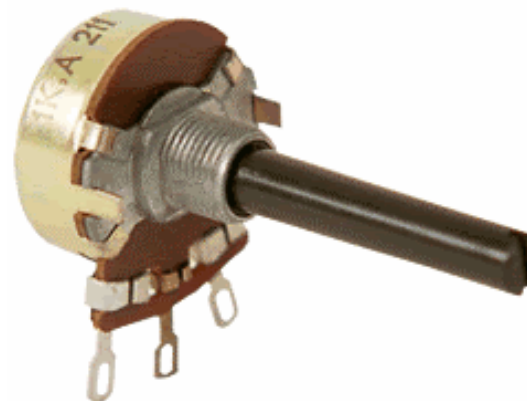
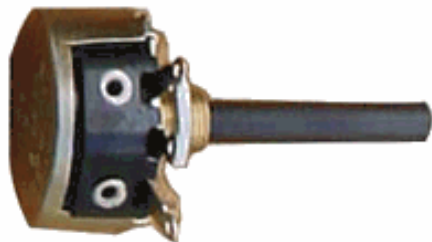
(a) External view



(b) Internal view

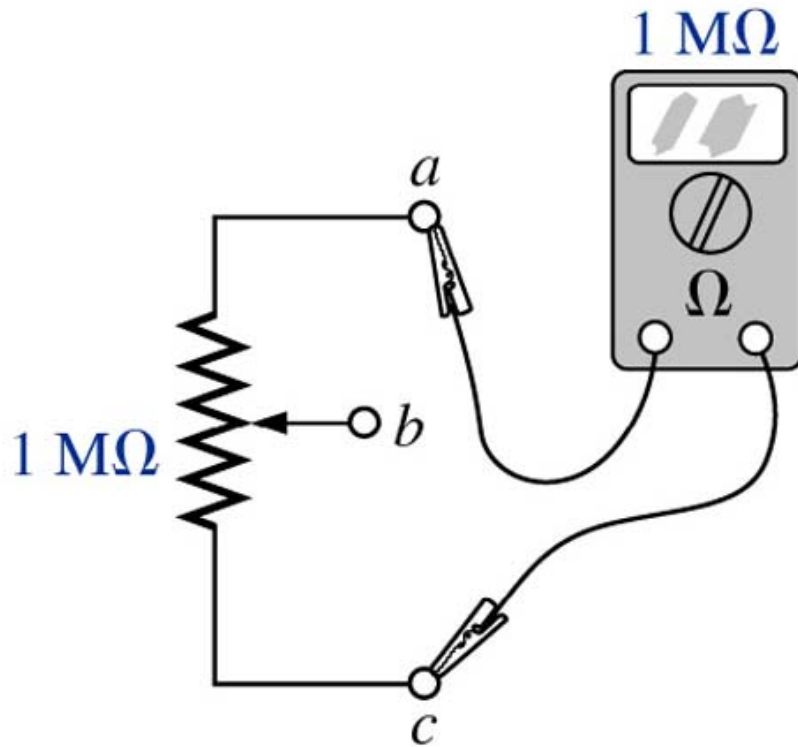


(c) Carbon element



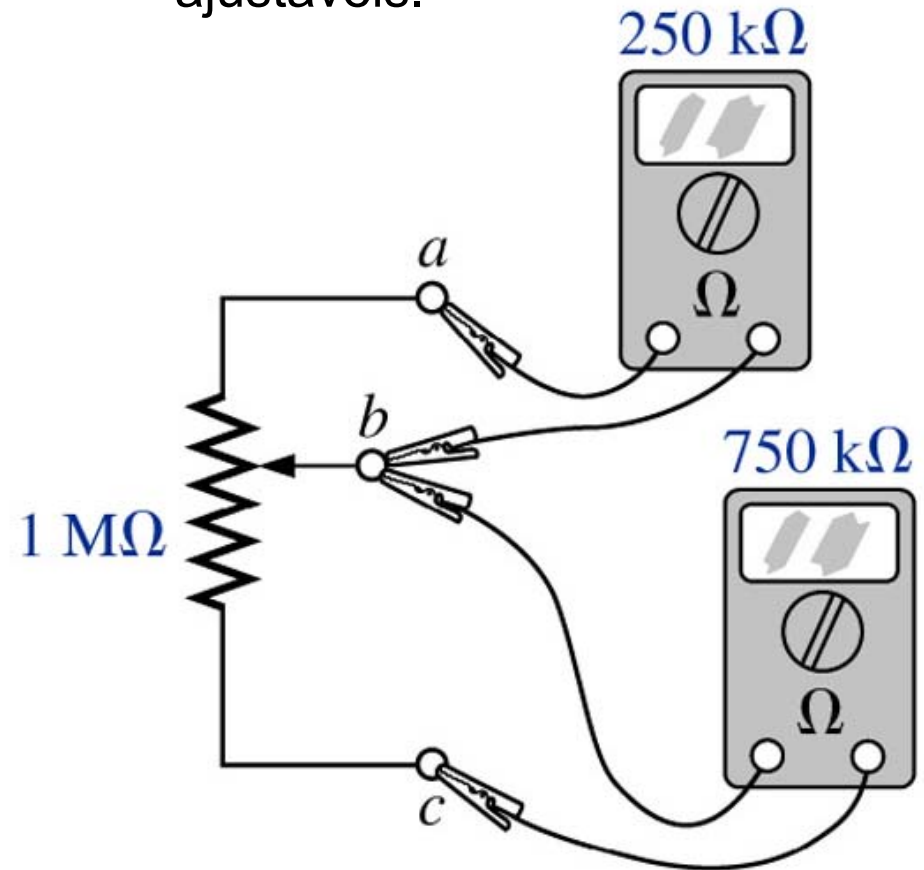
Resistores

Tipos de resistores:



(a)

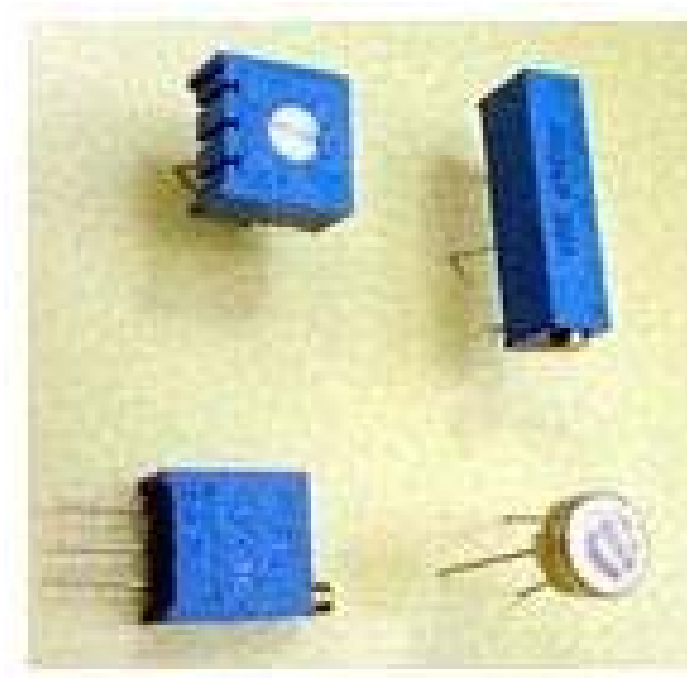
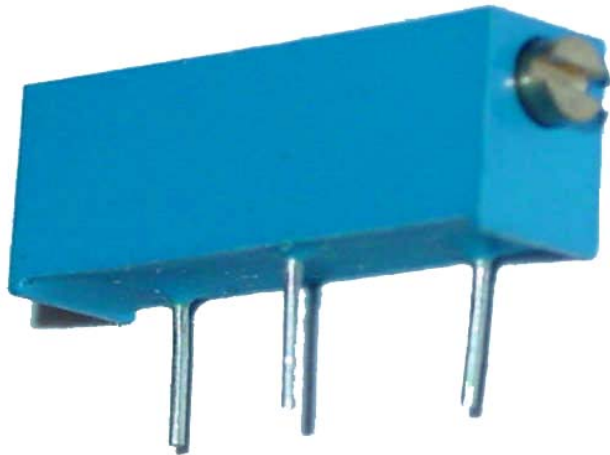
Resistores variáveis e ajustáveis.



(b)

Resistores

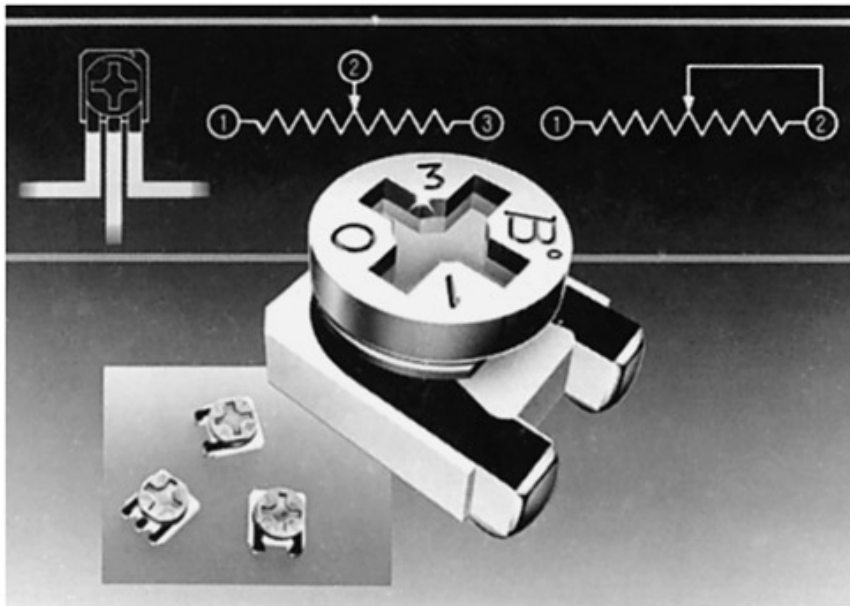
Tipos de resistores:



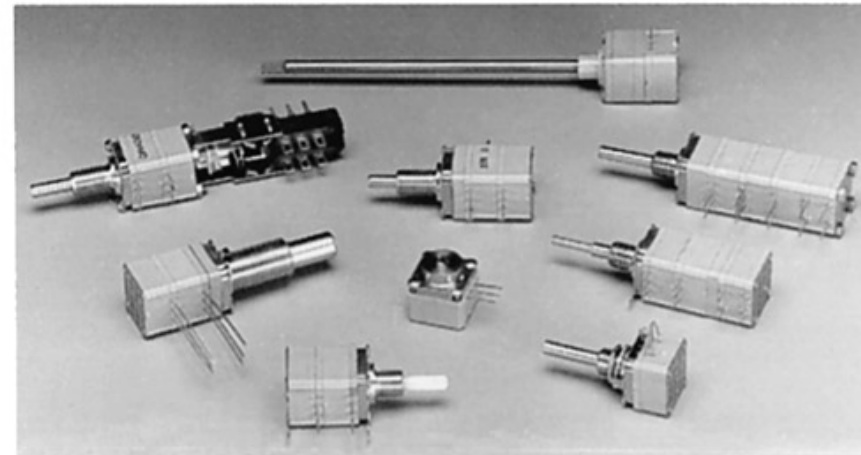
Resistores
variáveis e
ajustáveis.

Resistores

Tipos de resistores:



(a)



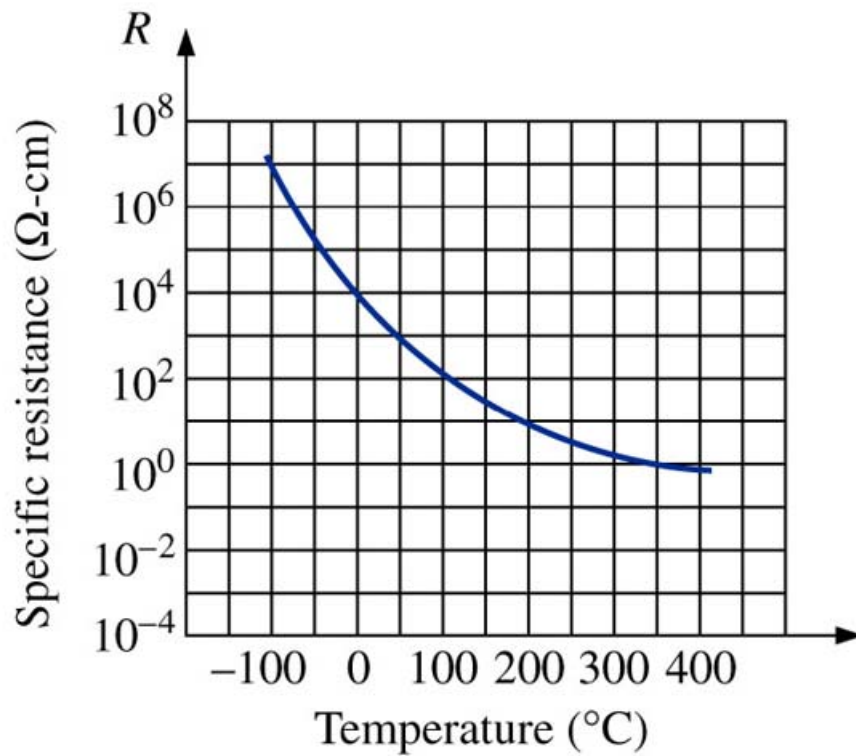
(b)

Potenciômetros
de precisão ou
multivoltas.

Termistores

Termistor:

- Resistor cuja resistência é sensível à variação da temperatura.



(a)



(b)

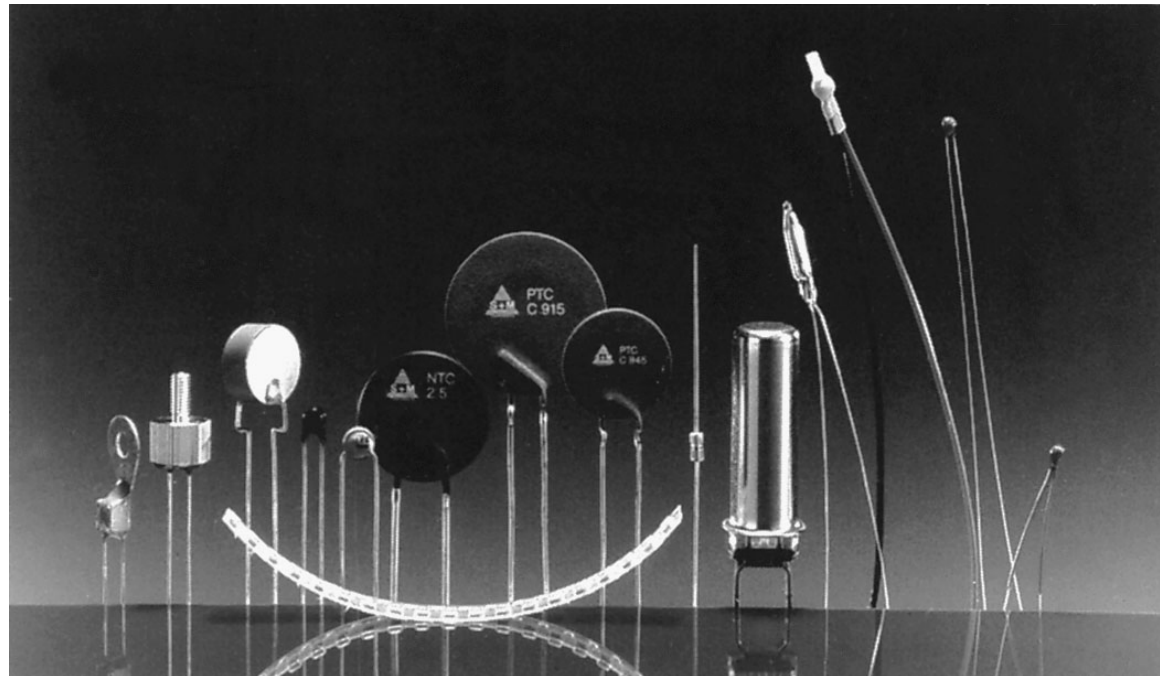
Termistores

Termistor NTC:

- Coeficiente negativo de temperatura;
- Resistência diminui com o aumento da temperatura.

Termistor PTC:

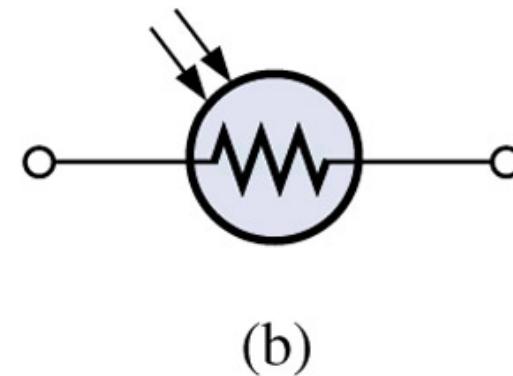
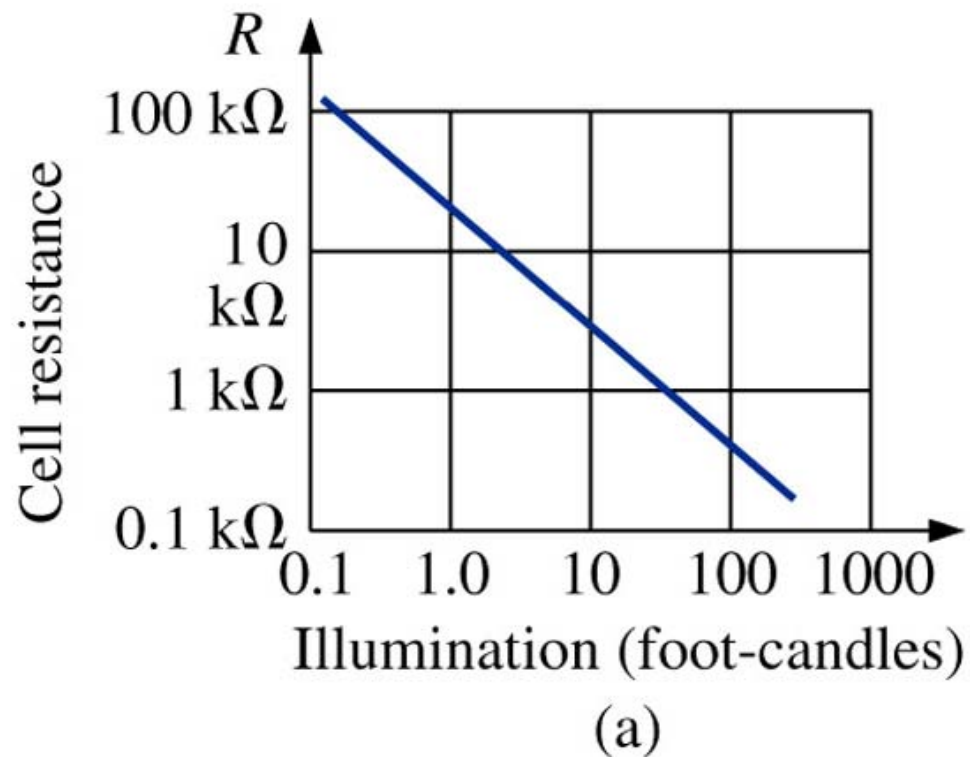
- Coeficiente positivo de temperatura;
- Resistência aumenta com o aumento da temperatura.



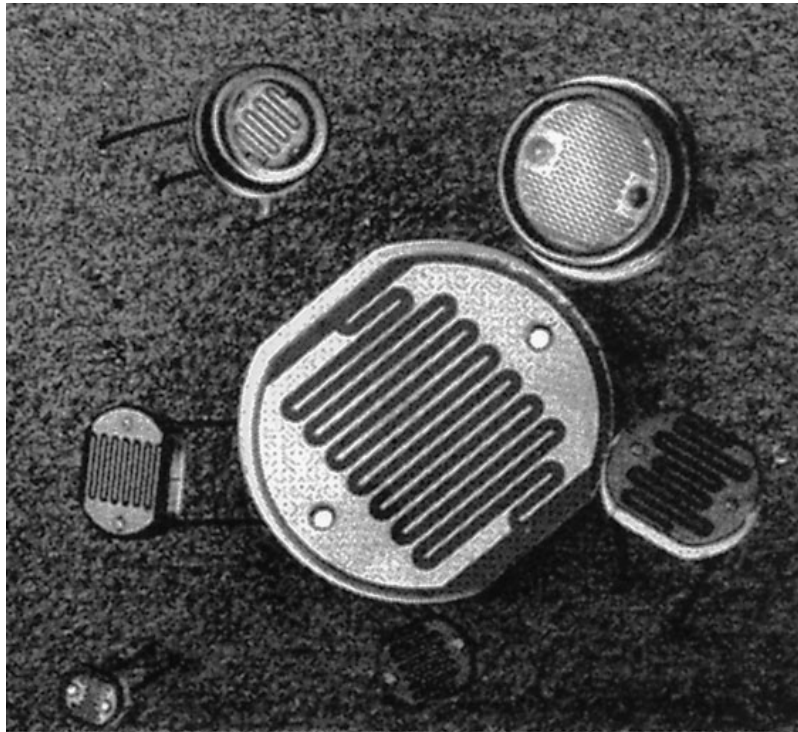
Célula fotocondutora ou LDR

LDR (Light dependent resistor) ou célula fotocondutora:

- A resistência é determinada pela intensidade da luz incidente em sua superfície.



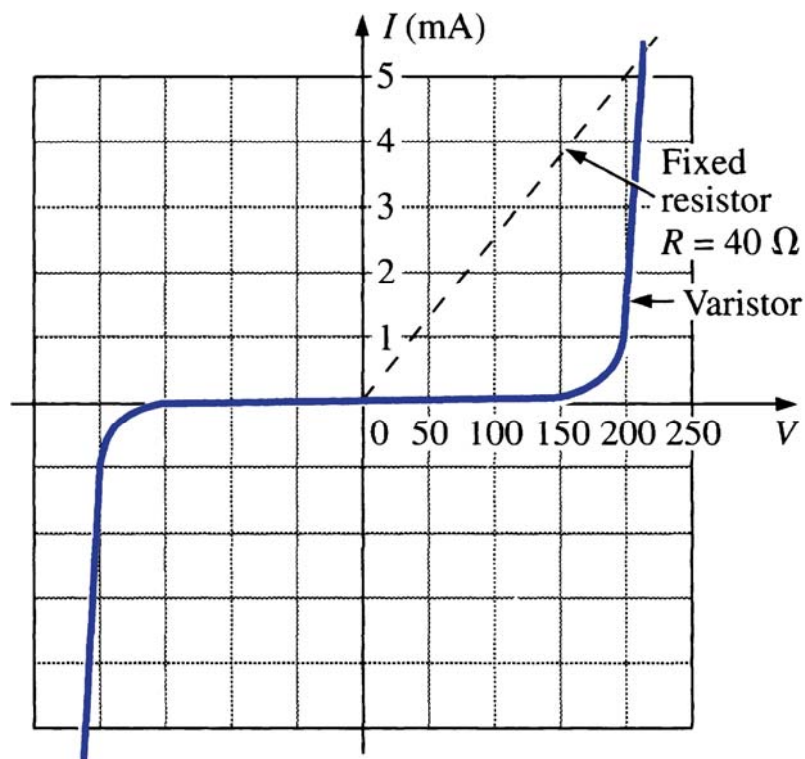
Célula fotocondutora ou LDR



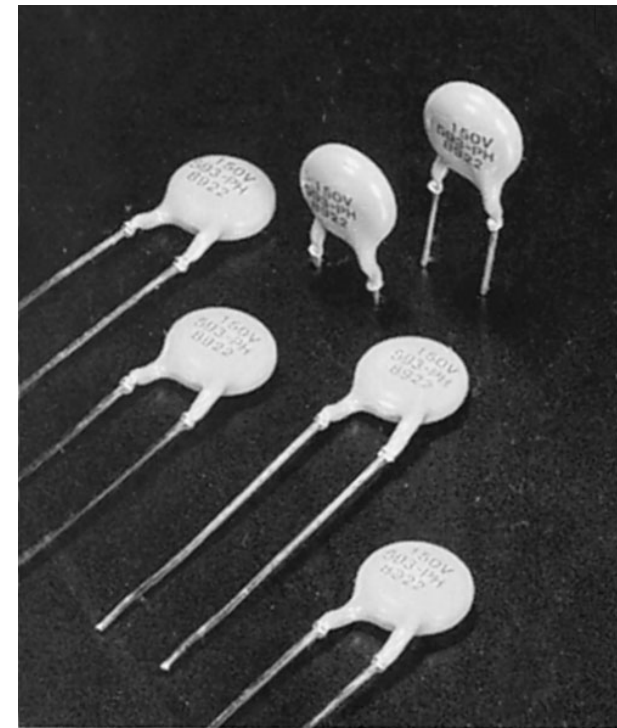
Varistores

Varistores:

- São resistores não-lineares, cuja resistência depende da tensão aplicada, usados para suprimir transientes de alta tensão.



(a)

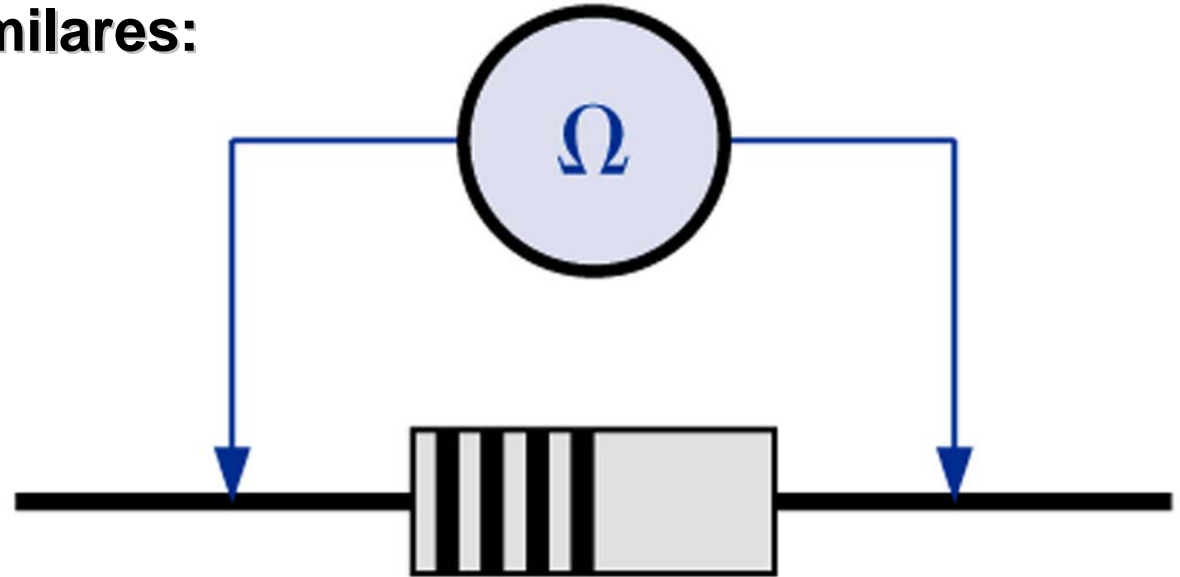


(b)

Resistores e similares

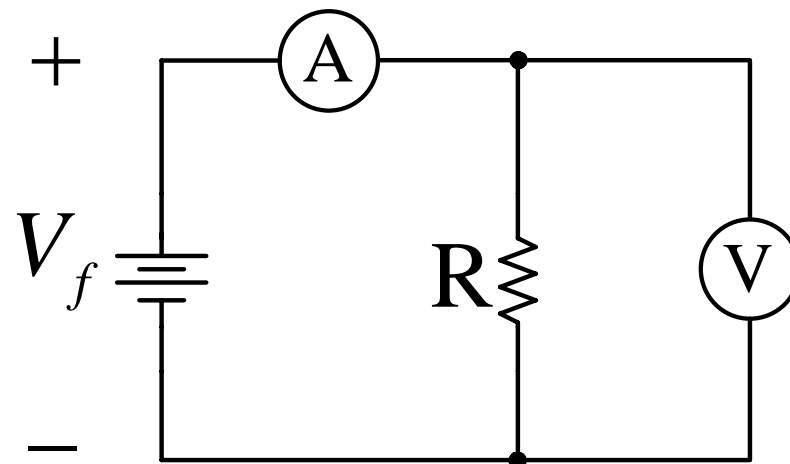
Testando resistores e similares:

Usando multímetro (Ω):



Aplicando a Lei de Ohm:

$$R = \frac{V}{I}$$



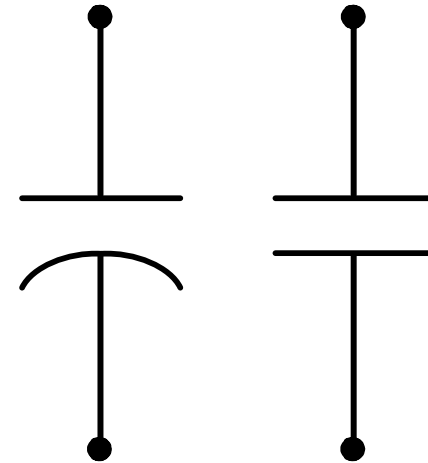
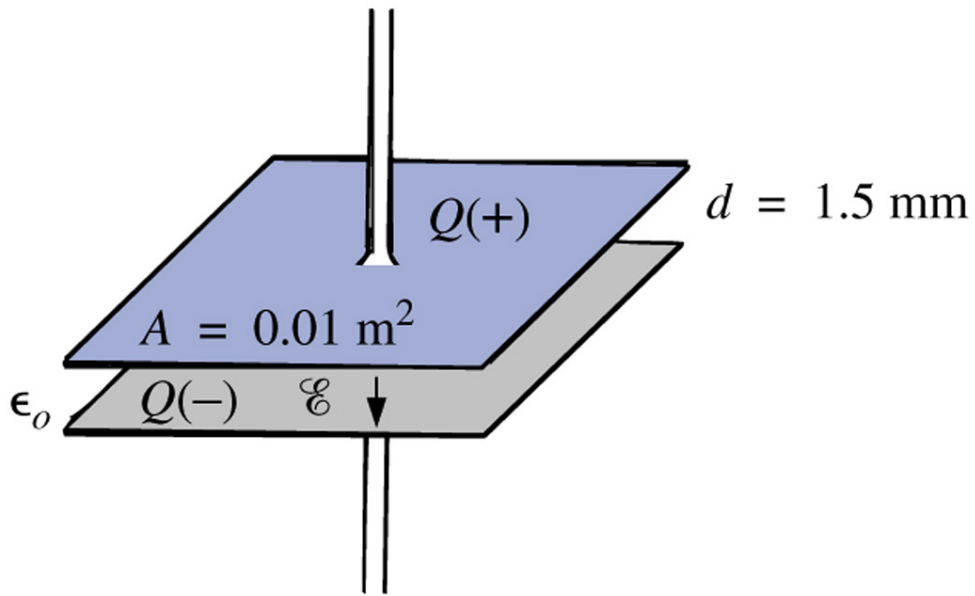
Parte B

Capacitores

Capacitores

Capacitância depende de:

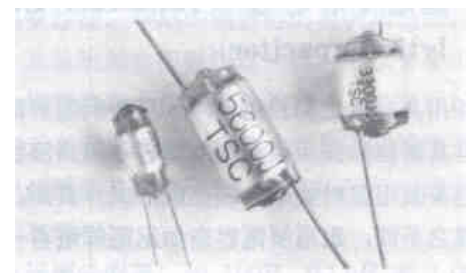
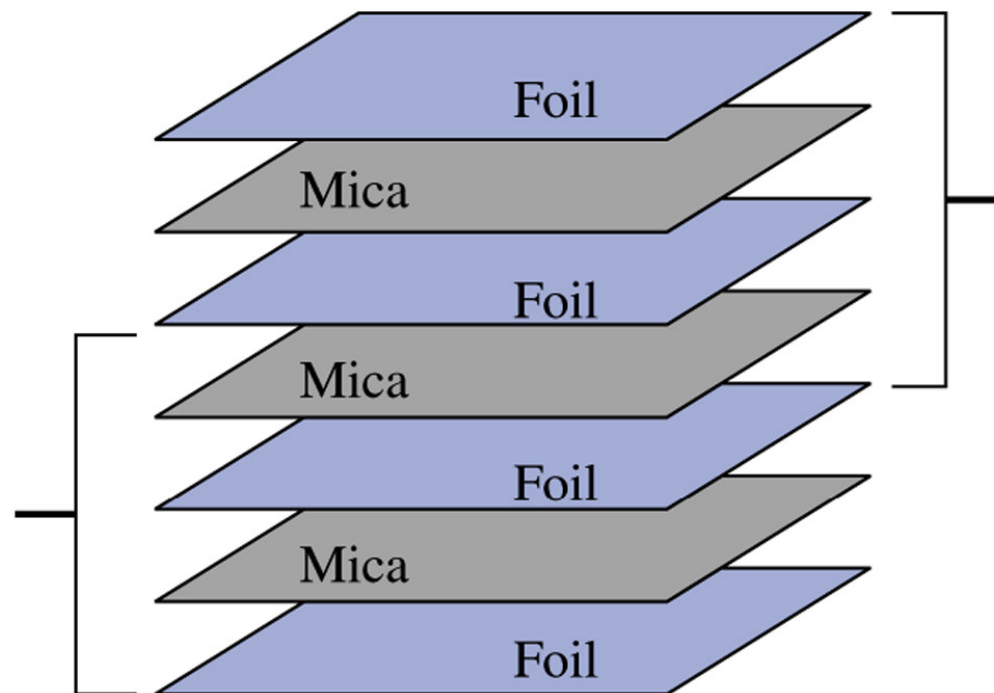
- Dielétrico (permissividade);
- Área das placas;
- Distância entre as placas.



Capacitores

Tipos de capacitores:

Capacitores fixos de mica.

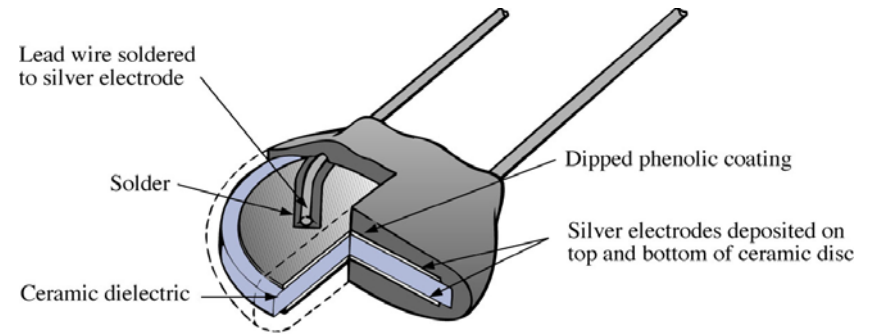


Capacitores

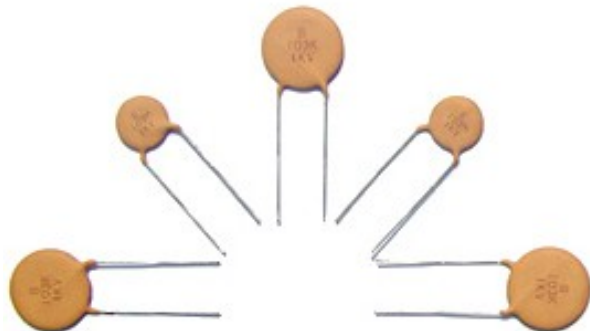
Tipos de capacitores:



Capacitores de disco de cerâmica.



(b)



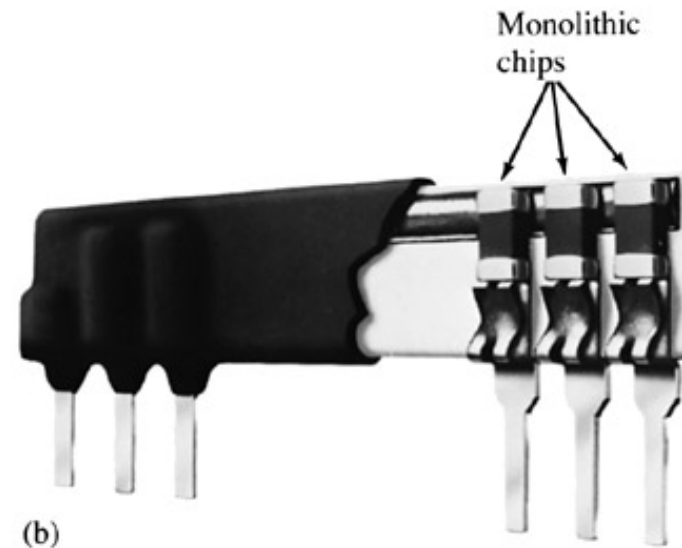
Capacitores

Tipos de capacitores:

Capacitores integrados.



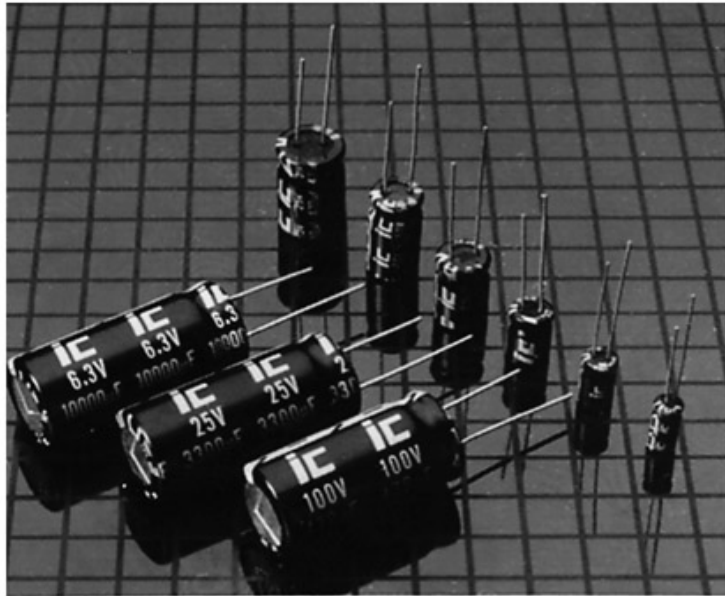
(a)



(b)

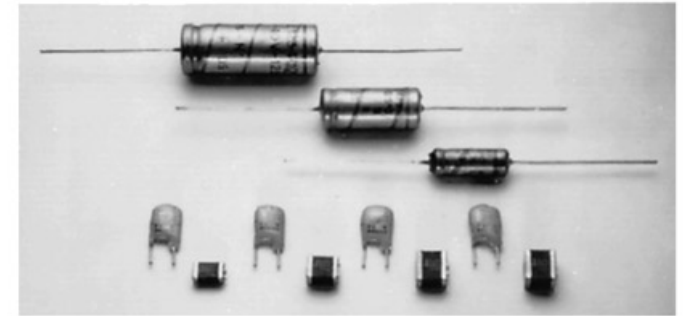
Capacitores

Tipos de capacitores:

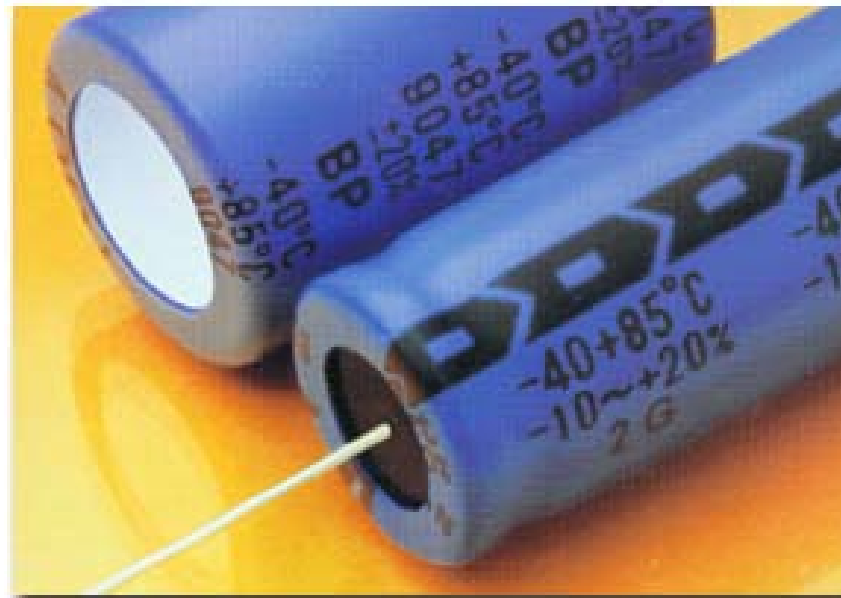


(a)

Capacitores eletrolíticos.



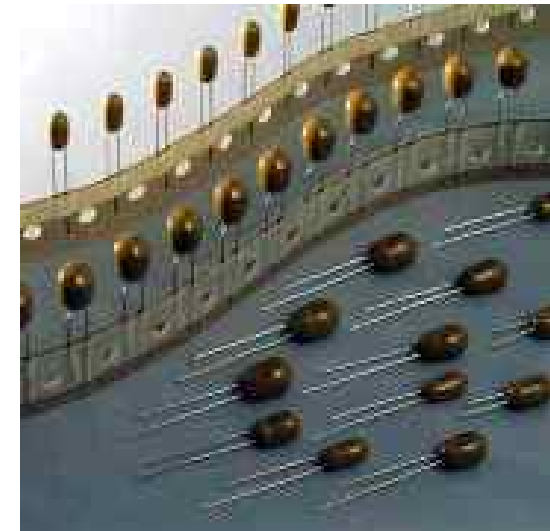
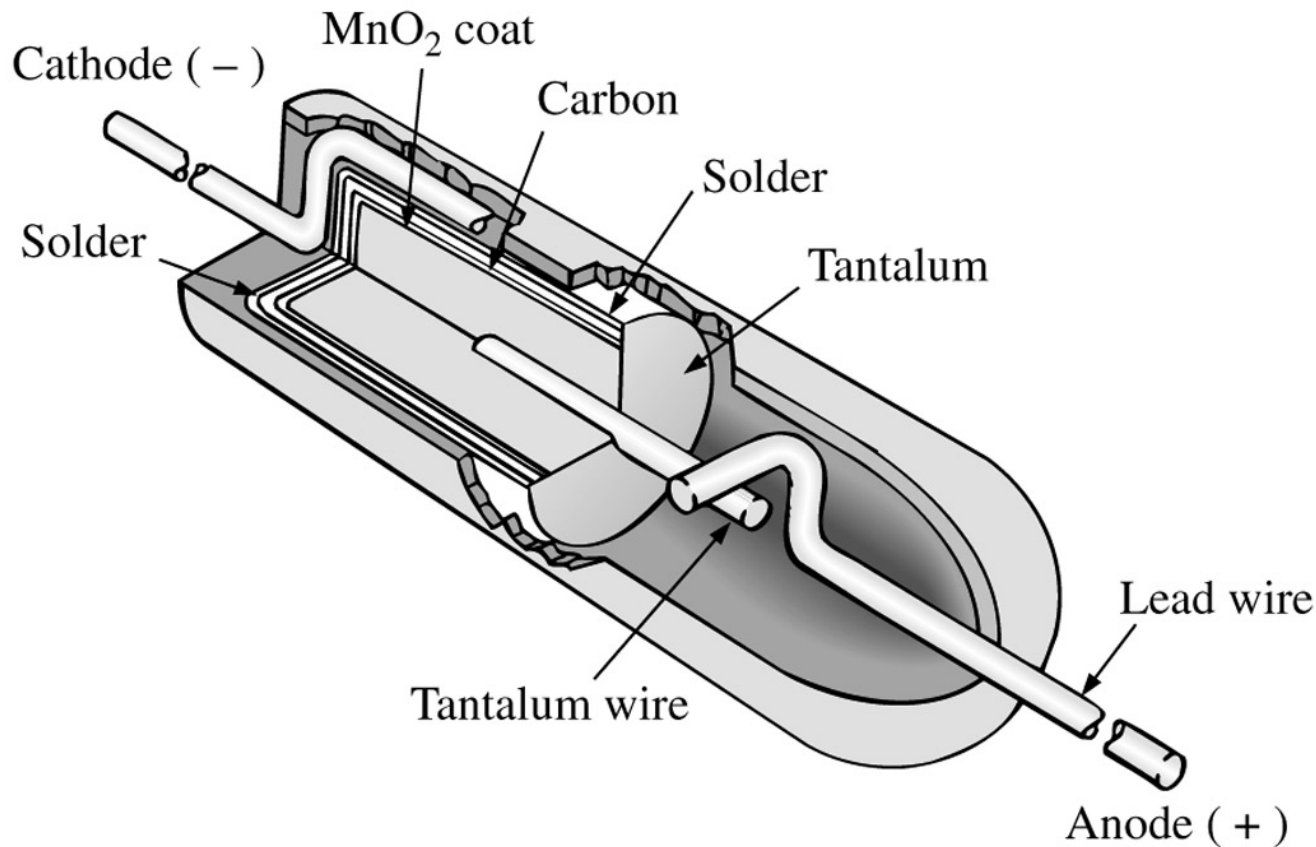
(b)



Capacitores

Tipos de capacitores:

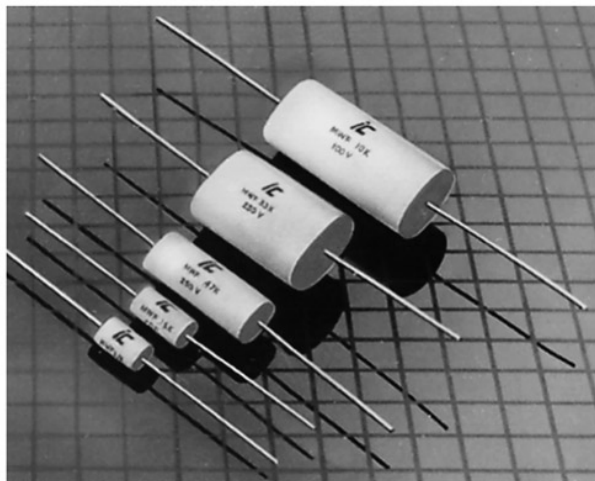
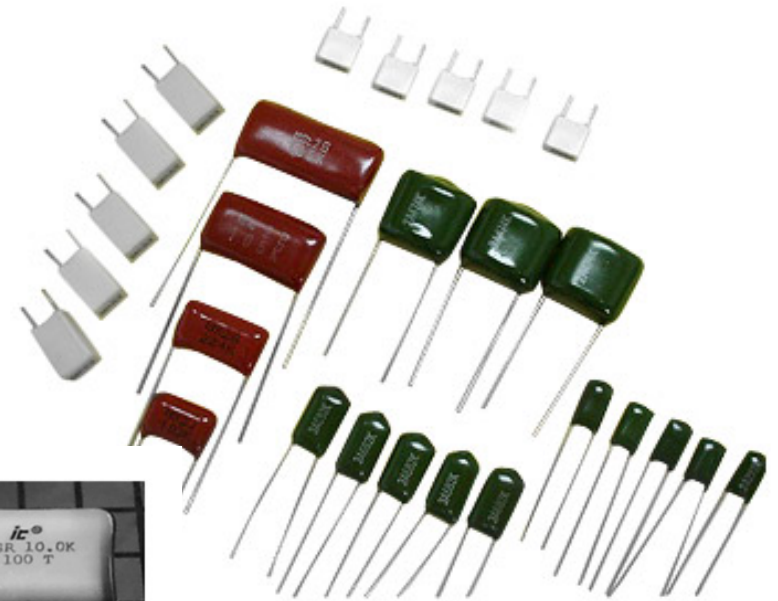
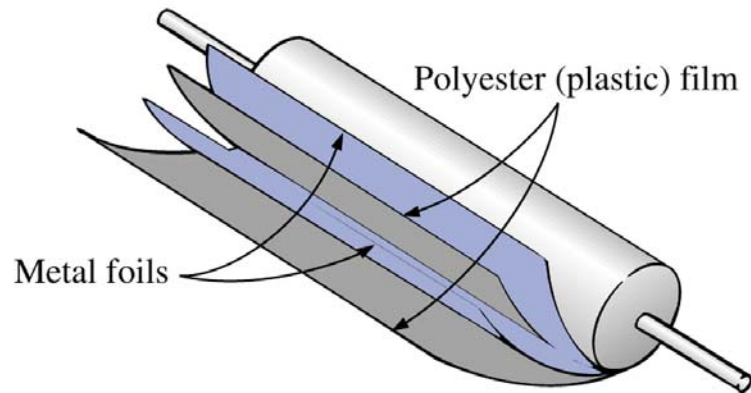
Capacitores de tântalo.



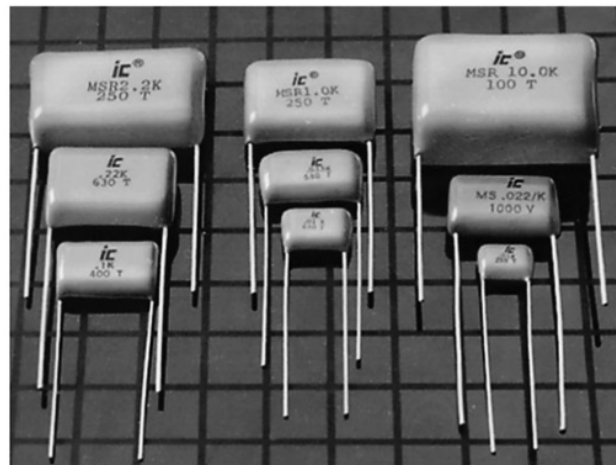
Capacitores

Tipos de capacitores:

Capacitores de filme de poliéster.



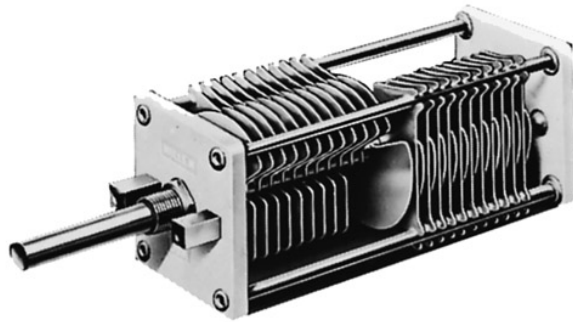
(a)



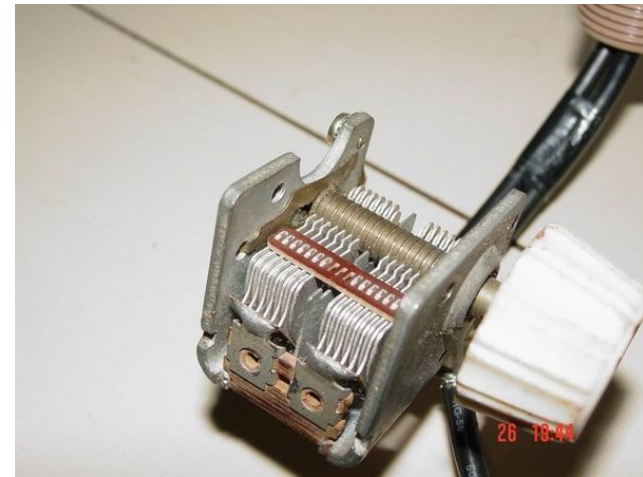
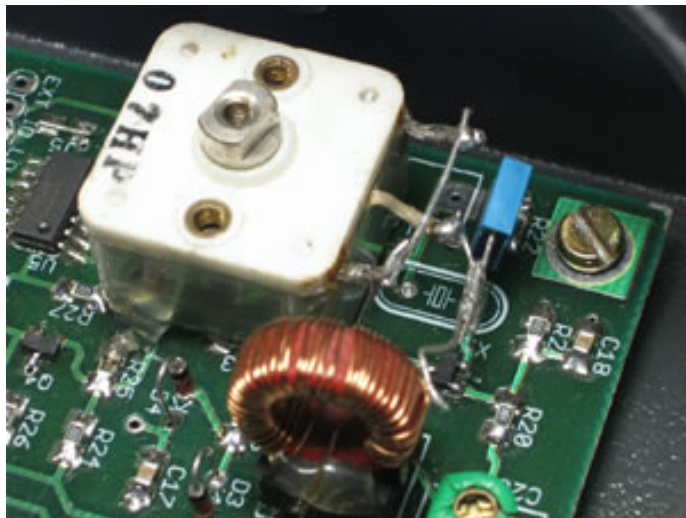
(b)

Capacitores

Tipos de capacitores:



Capacitores variáveis e ajustáveis.



Capacitores

Tipos de capacitores:

Super capacitores



Small capacitance	3F, 2.3V – 300F, 2.3V	back-up power, on-board UPS, etc.
Medium capacitance	300F, 2.3V – 5000F, 2.7V	peak power, UPS, etc.
Large capacitance	5000F, 2.7V – 80.000F, 1.8 V	peak power, low maintenance energy storage, etc.
Supercapacitor modules	5V- 700V, capacitance on request.	Higher voltage applications



Capacitores

Tipos de capacitores, resumo:

Type: Miniature Axial Electrolytic
Typical Values: 0.1 μF to 15,000 μF
Typical Voltage Range: 5 V to 450 V
Capacitor tolerance: $\pm 20\%$
Applications: Polarized, used in DC power supplies, bypass filters, DC blocking.



Type: Miniature Radial Electrolyte
Typical Values: 0.1 μF to 15,000 μF
Typical Voltage Range: 5 V to 450 V
Capacitor tolerance: $\pm 20\%$
Applications: Polarized, used in DC power supplies, bypass filters, DC blocking.



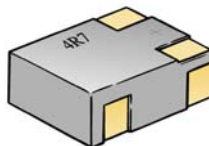
Type: Ceramic Disc
Typical Values: 10 pF to 0.047 μF
Typical Voltage Range: 100 V to 6 kV
Capacitor tolerance: $\pm 5\%$, $\pm 10\%$
Applications: Non-polarized, NPO type, stable for a wide range of temperatures. Used in oscillators, noise filters, circuit coupling, tank circuits.



Type: Dipped Tantalum (solid and wet)
Typical Values: 0.047 μF to 470 μF
Typical Voltage Range: 6.3 V to 50 V
Capacitor tolerance: $\pm 10\%$, $\pm 20\%$
Applications: Polarized, low leakage current, used in power supplies, high frequency noise filters, bypass filter.



Type: Surface Mount Type (SMT)
Typical Values: 10 pF to 10 μF
Typical Voltage Range: 6.3 V to 16 V
Capacitor tolerance: $\pm 10\%$
Applications: Polarized and non-polarized, used in all types of circuits, requires a minimum amount of PC board real estate.



Type: Silver Mica
Typical Value: 10 pF to 0.001 μF
Typical Voltage Range: 50 V to 500 V
Capacitor tolerance: $\pm 5\%$
Applications: Non-polarized, used in oscillators, in circuits that require a stable component over a range of temperatures and voltages.



Type: Mylar Paper
Typical Value: 0.001 μF to 0.68 μF
Typical Voltage Range: 50 V to 600 V
Capacitor tolerance: $\pm 22\%$
Applications: Non-polarized, used in all types of circuits, moisture resistant.



Type: AC/DC Motor Run
Typical Value: 0.25 μF to 1200 μF
Typical Voltage Range: 240 V to 660 V
Capacitor tolerance: $\pm 10\%$
Applications: Non-polarized, used in motor run-start, high-intensity lighting supplies, AC noise filtering.



Type: Trimmer Variable
Typical Value: 1.5 pF to 600 pF
Typical Voltage Range: 5 V to 100 V
Capacitor tolerance: $\pm 10\%$
Applications: Non-polarized, used in oscillators, tuning circuits, AC filters.



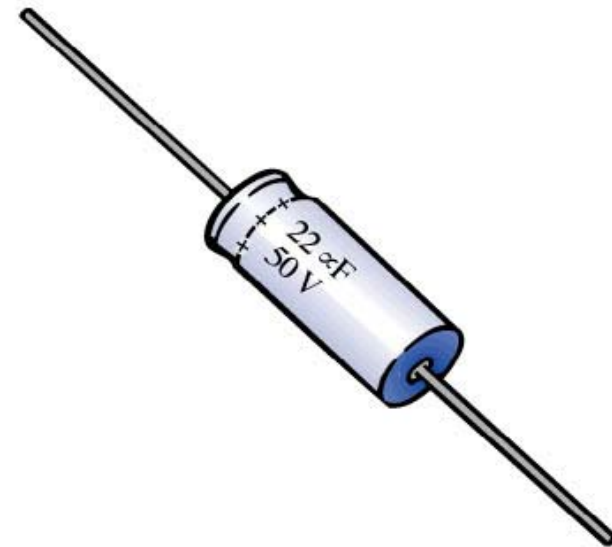
Type: Tuning variable
Typical Value: 10 pF to 600 pF
Typical Voltage Range: 5 V to 100 V
Capacitor tolerance: $\pm 10\%$
Applications: Non-polarized, used in oscillators, radio tuning circuit.



Capacitores

Tipos de capacitores:

Type: Miniature Axial Electrolytic
Typical Values: 0.1 μF to 15,000 μF
Typical Voltage Range: 5 V to 450 V
Capacitor tolerance: $\pm 20\%$
Applications: Polarized, used in DC power supplies, bypass filters, DC blocking.



Capacitores

Tipos de capacitores:

Type: Miniature Radial Electrolyte

Typical Values: 0.1 μF to 15,000 μF

Typical Voltage Range: 5 V to 450 V

Capacitor tolerance: $\pm 20\%$

Applications: Polarized, used in DC power supplies, bypass filters, DC blocking.



Capacitores

Tipos de capacitores:

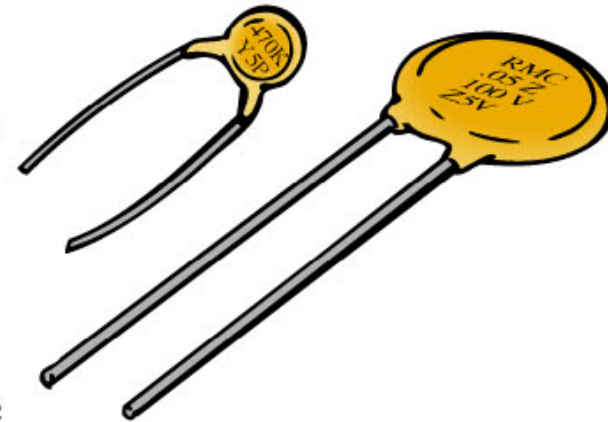
Type: Ceramic Disc

Typical Values: 10 pF to 0.047 μ F

Typical Voltage Range: 100 V to 6 kV

Capacitor tolerance: $\pm 5\%$, $\pm 10\%$

Applications: Non-polarized, NPO type, stable for a wide range of temperatures. Used in oscillators, noise filters, circuit coupling, tank circuits.



Capacitores

Tipos de capacitores:

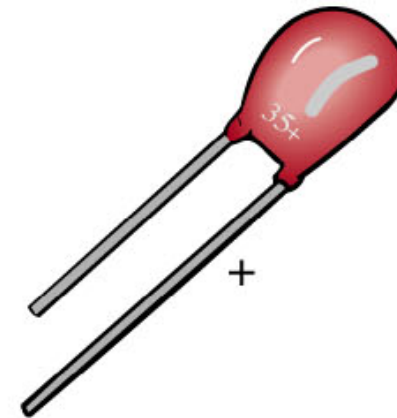
Type: Dipped Tantalum (solid and wet)

Typical Values: 0.047 μ F to 470 μ F

Typical Voltage Range: 6.3 V to 50 V

Capacitor tolerance: $\pm 10\%$, $\pm 20\%$

Applications: Polarized, low leakage current, used in power supplies, high frequency noise filters, bypass filter.



Capacitores

Tipos de capacitores:

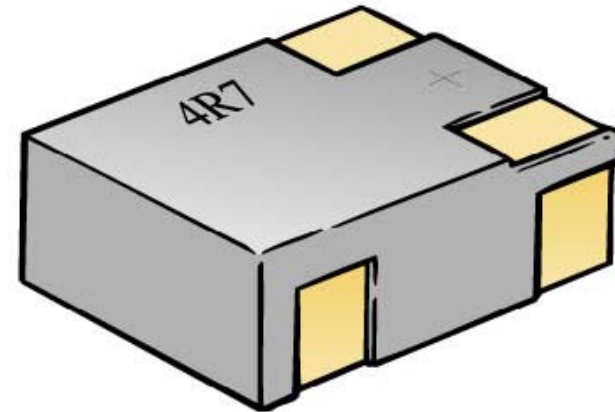
Type: Surface Mount Type (SMT)

Typical Values: 10 pF to 10 μ F

Typical Voltage Range: 6.3 V to 16 V

Capacitor tolerance: $\pm 10\%$

Applications: Polarized and non-polarized, used in all types of circuits, requires a minimum amount of PC board real estate.



Capacitores

Tipos de capacitores:

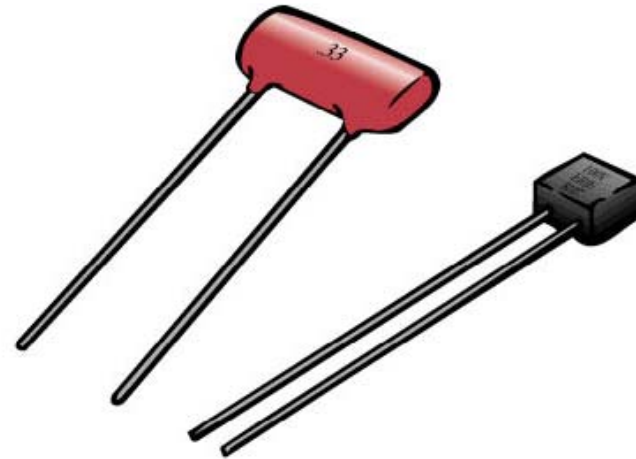
Type: Silver Mica

Typical Value: 10 pF to 0.001 μ F

Typical Voltage Range: 50 V to 500 V

Capacitor tolerance: $\pm 5\%$

Applications: Non-polarized, used in oscillators, in circuits that require a stable component over a range of temperatures and voltages.



Capacitores

Tipos de capacitores:

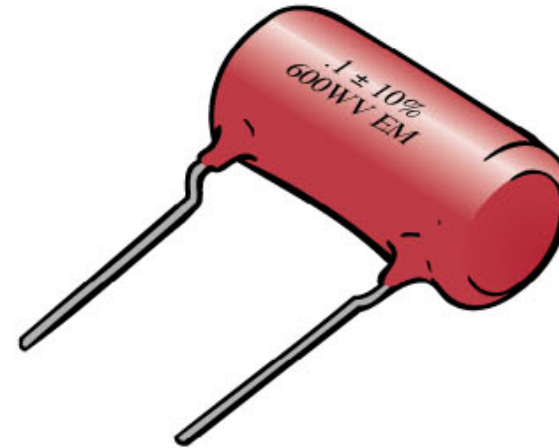
Type: Mylar Paper

Typical Value: 0.001 μF to 0.68 μF

Typical Voltage Range: 50 V to 600 V

Capacitor tolerance: $\pm 22\%$

Applications: Non-polarized, used in all types of circuits, moisture resistant.



Capacitores

Tipos de capacitores:

Type: AC/DC Motor Run

Typical Value: 0.25 μ F to 1200 μ F

Typical Voltage Range: 240 V to 660 V

Capacitor tolerance: $\pm 10\%$

Applications: Non-polarized, used in motor run-start, high-intensity lighting supplies, AC noise filtering.



Capacitores

Tipos de capacitores:

Type: Trimmer Variable

Typical Value: 1.5 pF to 600 pF

Typical Voltage Range: 5 V to 100 V

Capacitor tolerance: $\pm 10\%$

Applications: Non-polarized, used in oscillators, tuning circuits, AC filters.



Capacitores

Tipos de capacitores:

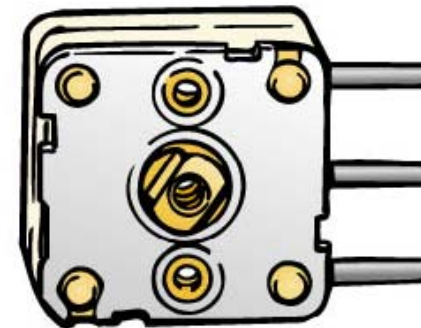
Type: Tuning variable

Typical Value: 10 pF to 600 pF

Typical Voltage Range: 5 V to 100 V

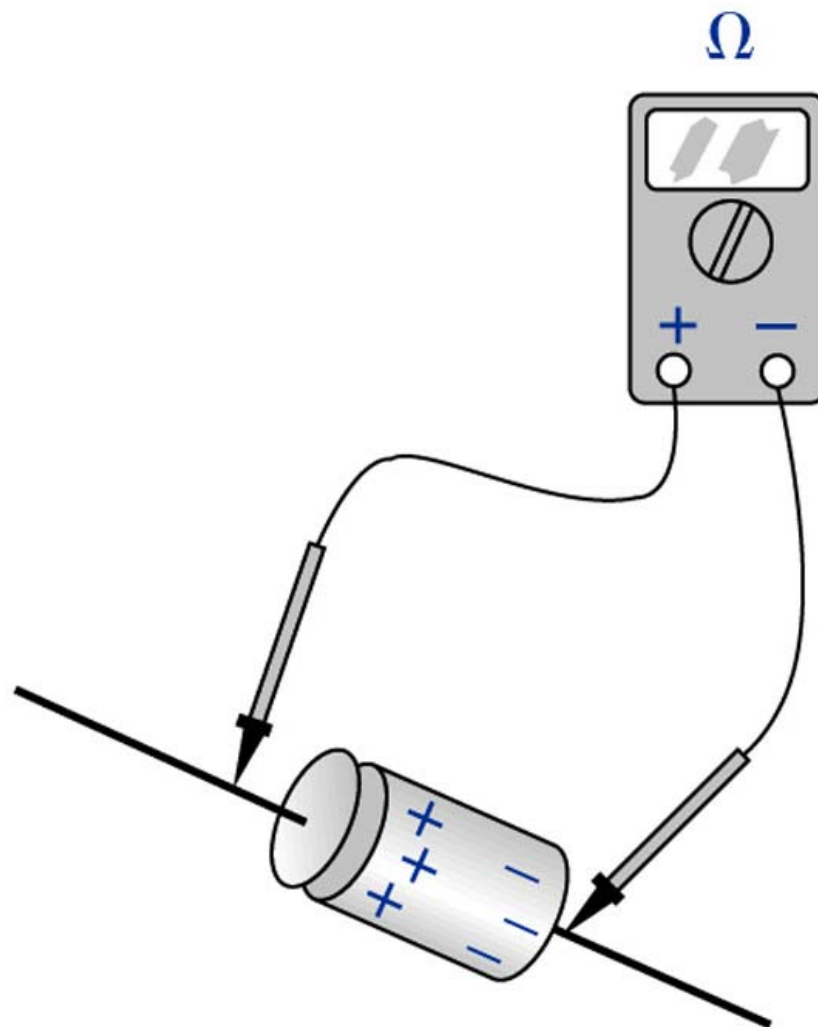
Capacitor tolerance: $\pm 10\%$

Applications: Non-polarized, used in oscillators, radio tuning circuit.



Capacitores

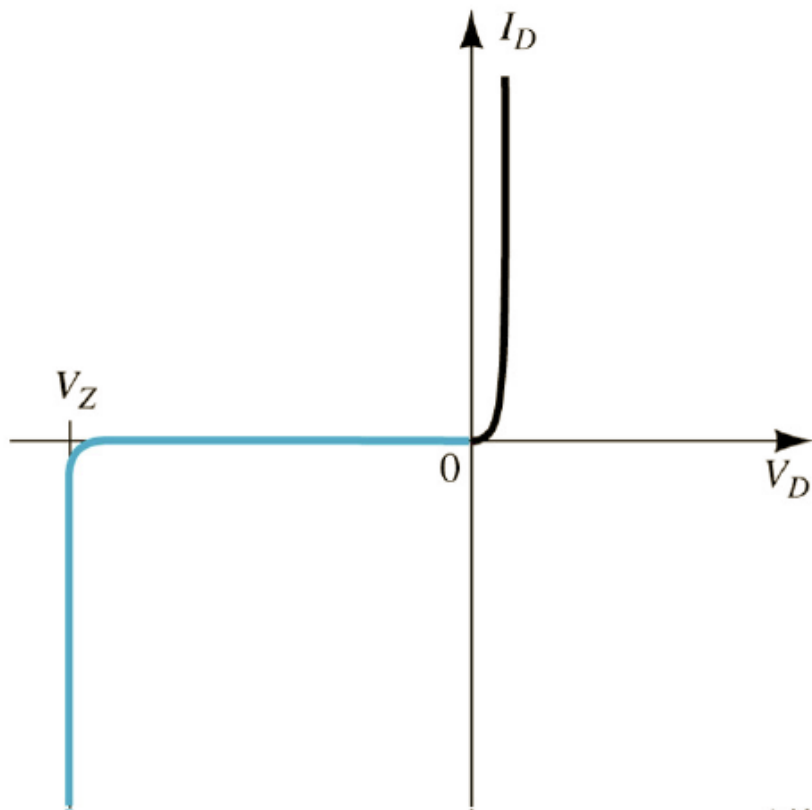
Testando capacitores:



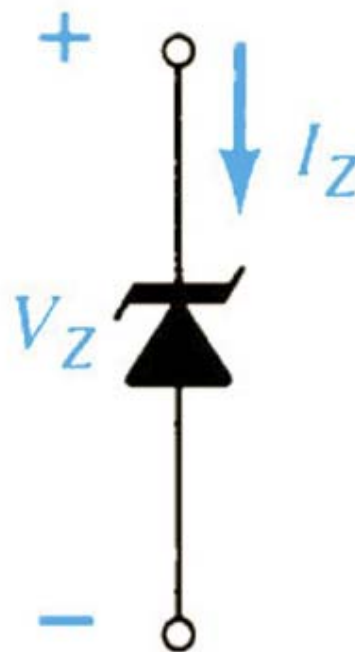
Parte C

Diodos

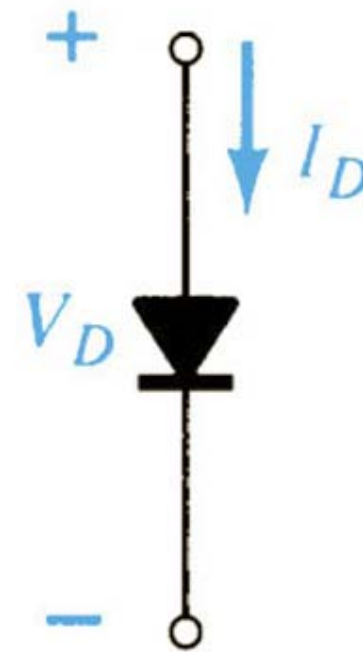
Diodos zener



Curva $I_D \times V_D$

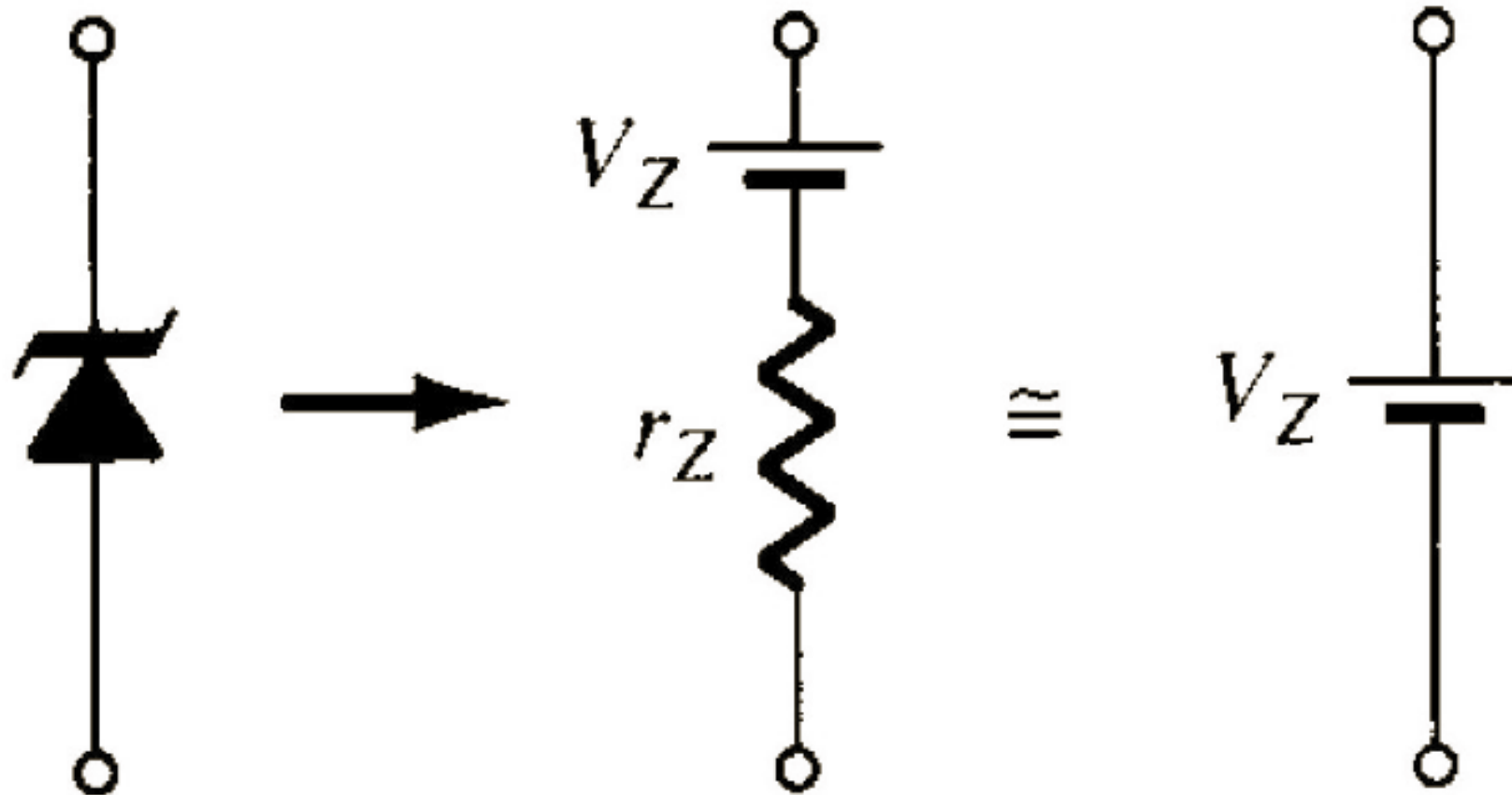


Diodo zener



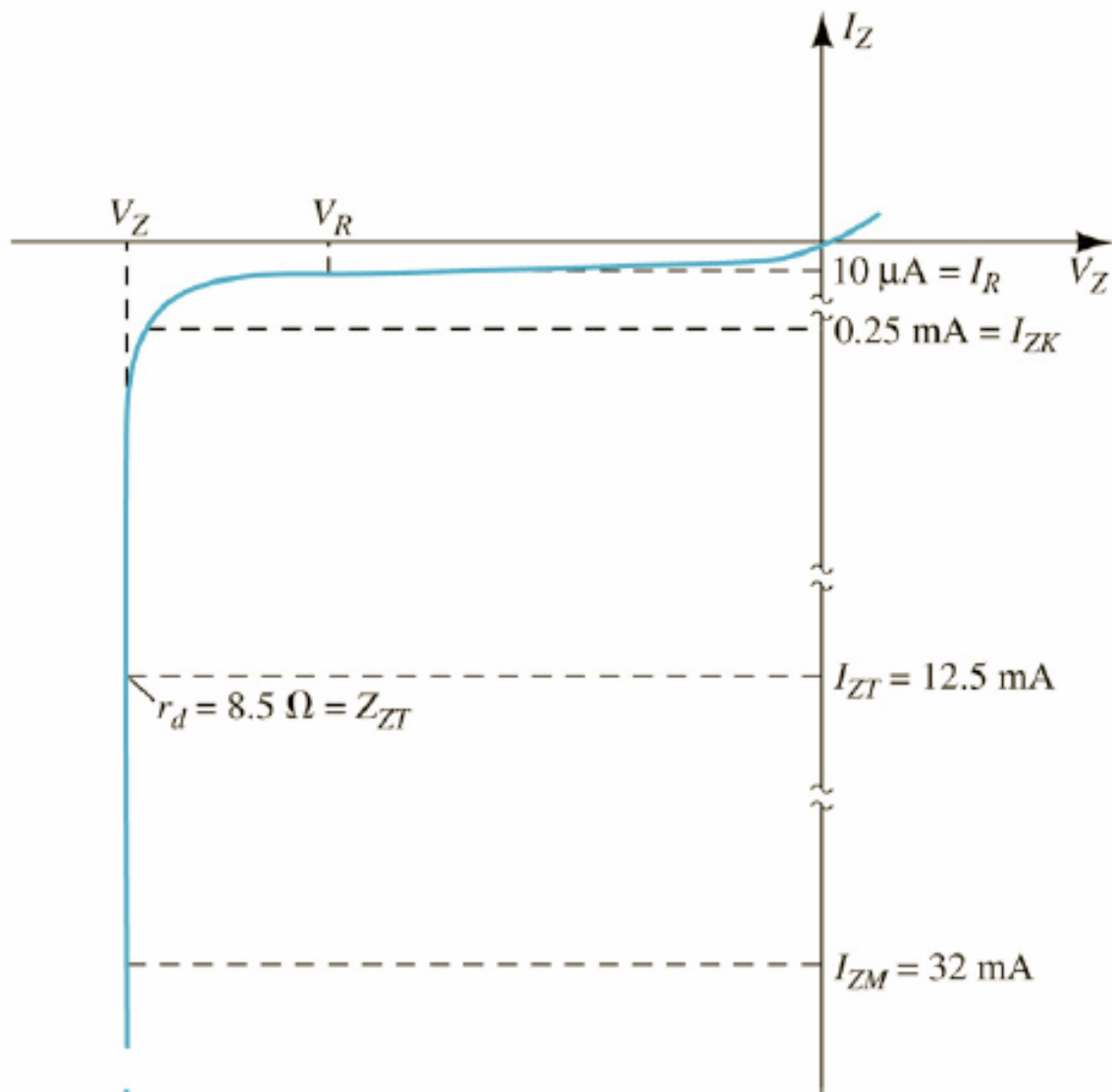
Diodo convencional

Diodos zener



Circuitos equivalentes do diodo zener

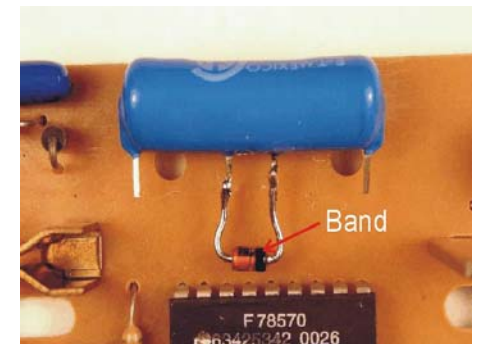
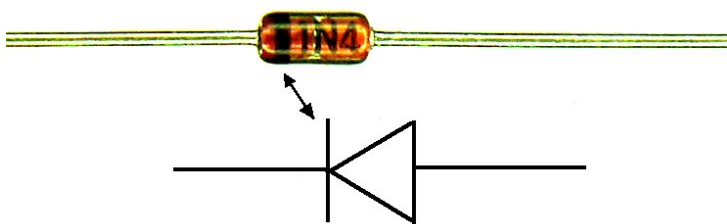
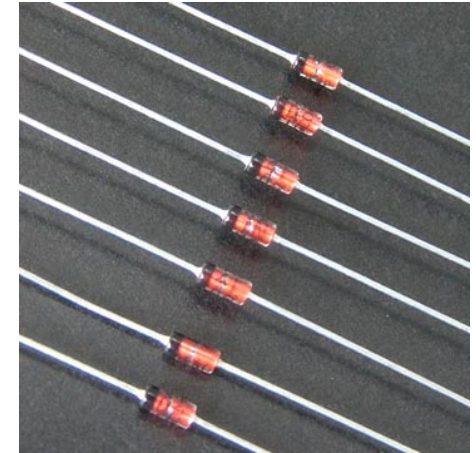
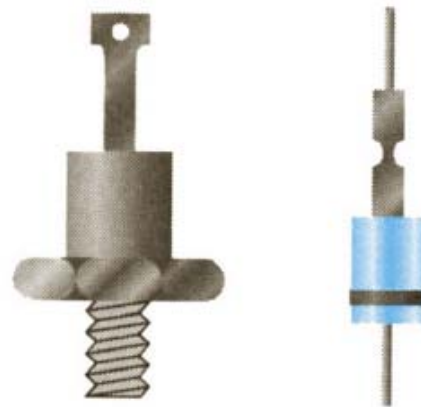
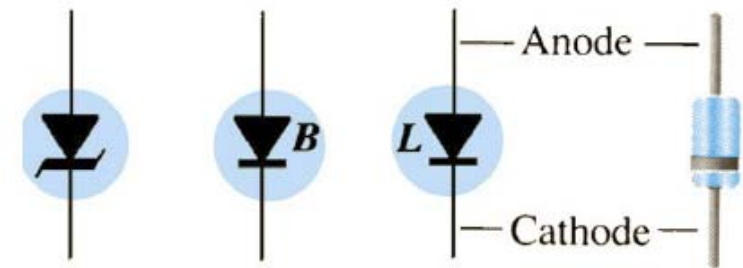
Diodos zener



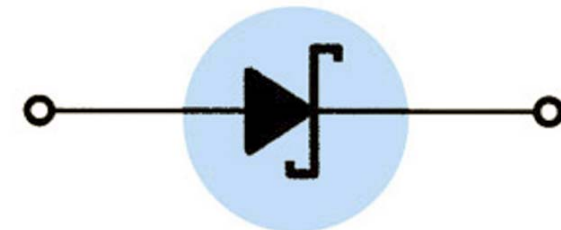
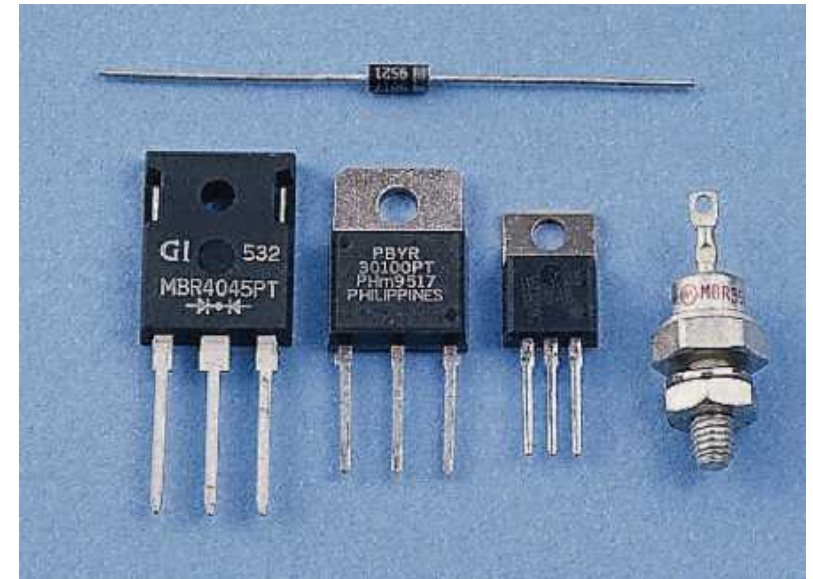
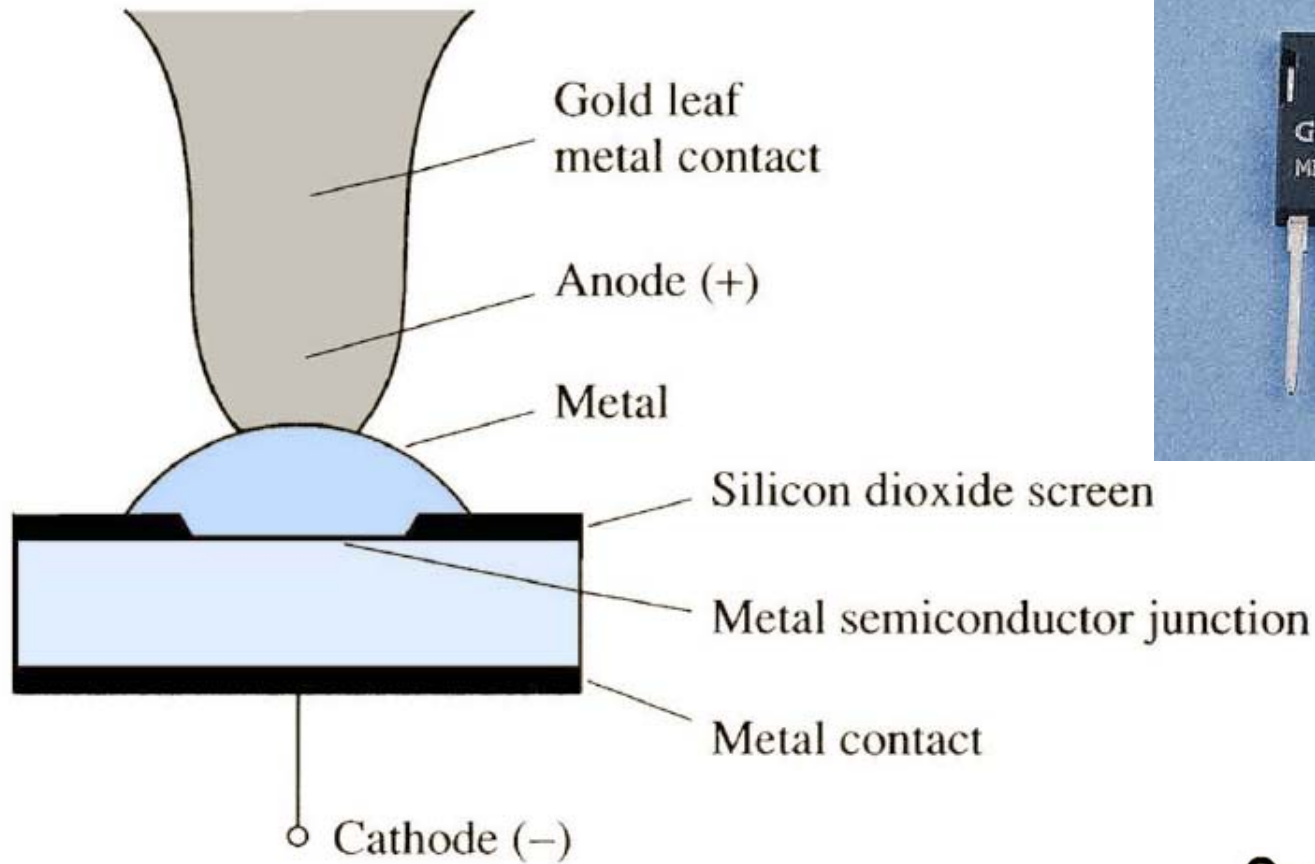
Curva $I_D \times V_D$

Diodos zener

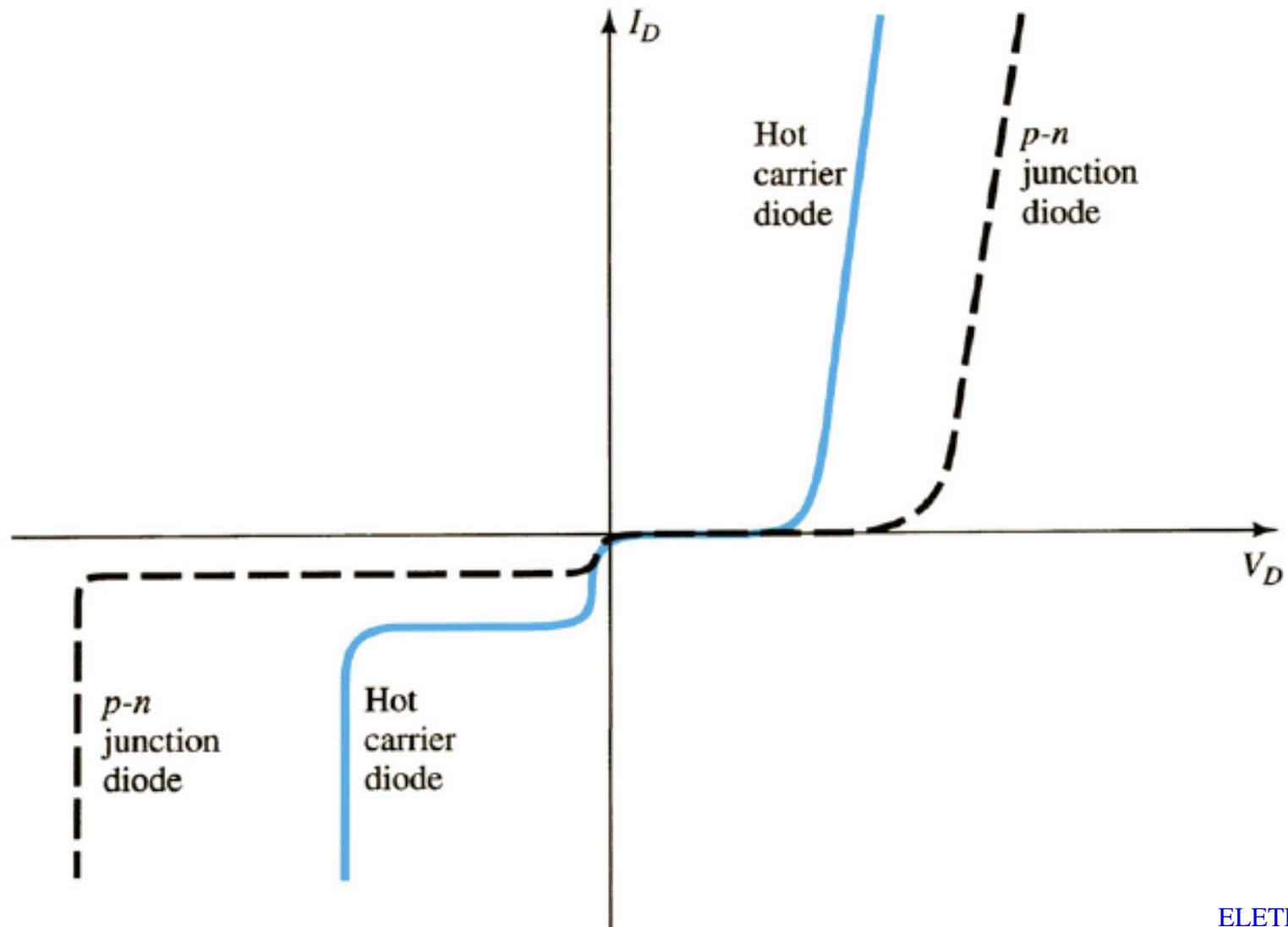
Aspectos de diodos zener:



Diodos de barreira Schottky



Diodos de barreira Schottky



Diodos de barreira Schottky

V_{RRM} (Volts)	Case	0.5 A	1.0 A	
		51-02 (DO-7) Glass	59-04 Plastic	
	Anode			
	Cathode:			
20		MBR020	IN5817	MBR120P
30		MBR030	IN5818	MBR130P
35				MBR135P
40			IN5819	MBR140P
I_{FSM} (Amps)		5.0	100	50
T_C @ Rated I_o (°C)				
T_J Max		125°C	125°C	125°C
Max V_F @ $I_{FSM} = I_o$		0.50 V	*0.60 V	0.65 V

Symb.	1N 4001	1N 4002	1N 4003	1N 4004	1N 4005
VRRM	50	100	200	400	600
VRMS	35	70	140	280	420
VDC	50	100	200	400	600
$I_{F(AV)}$	1.0				
I_{FSM}	30				
$I_{R(AV)}$	30				
$R_{\theta JA}$ $R_{\theta JL}$	50 25				
T_A	+150				
T_J, T_{STG}	-50 to +175				
V_F	1.1				

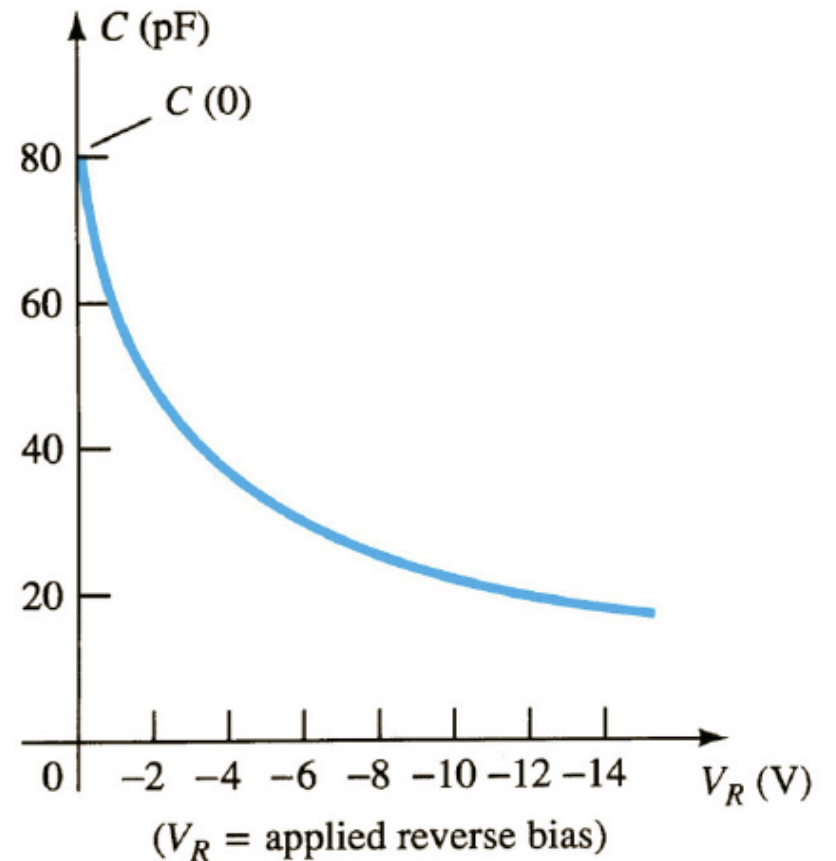
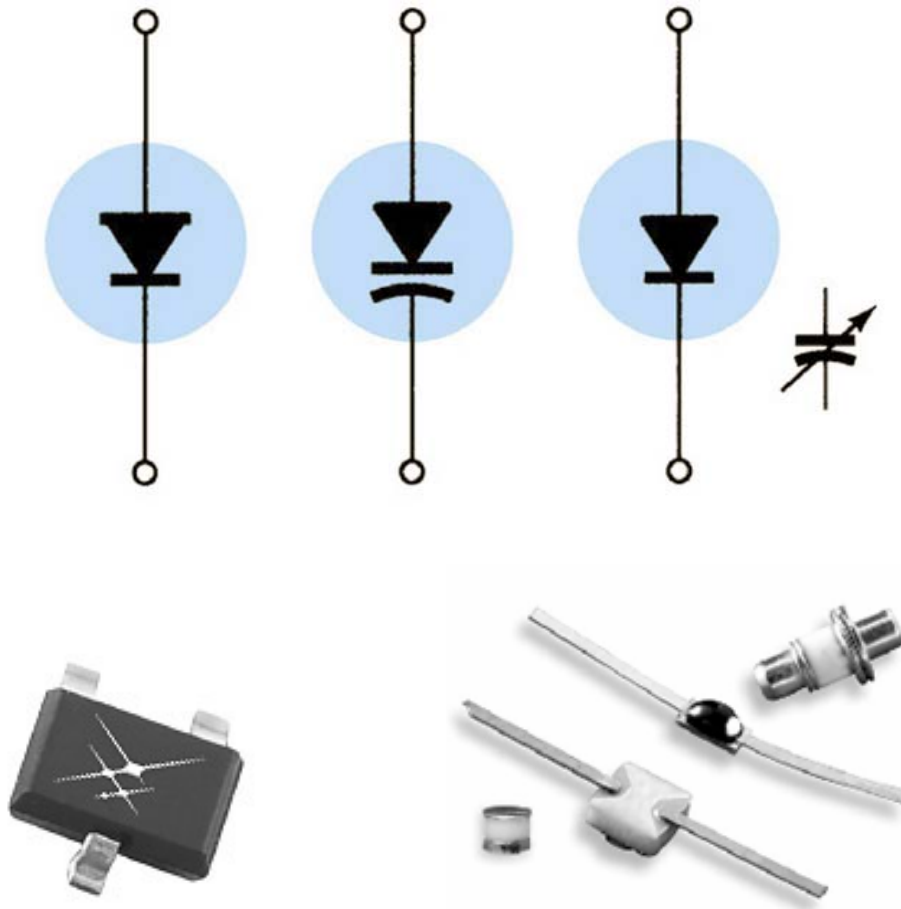
Diodo retificador normal

← Diodo Schottky

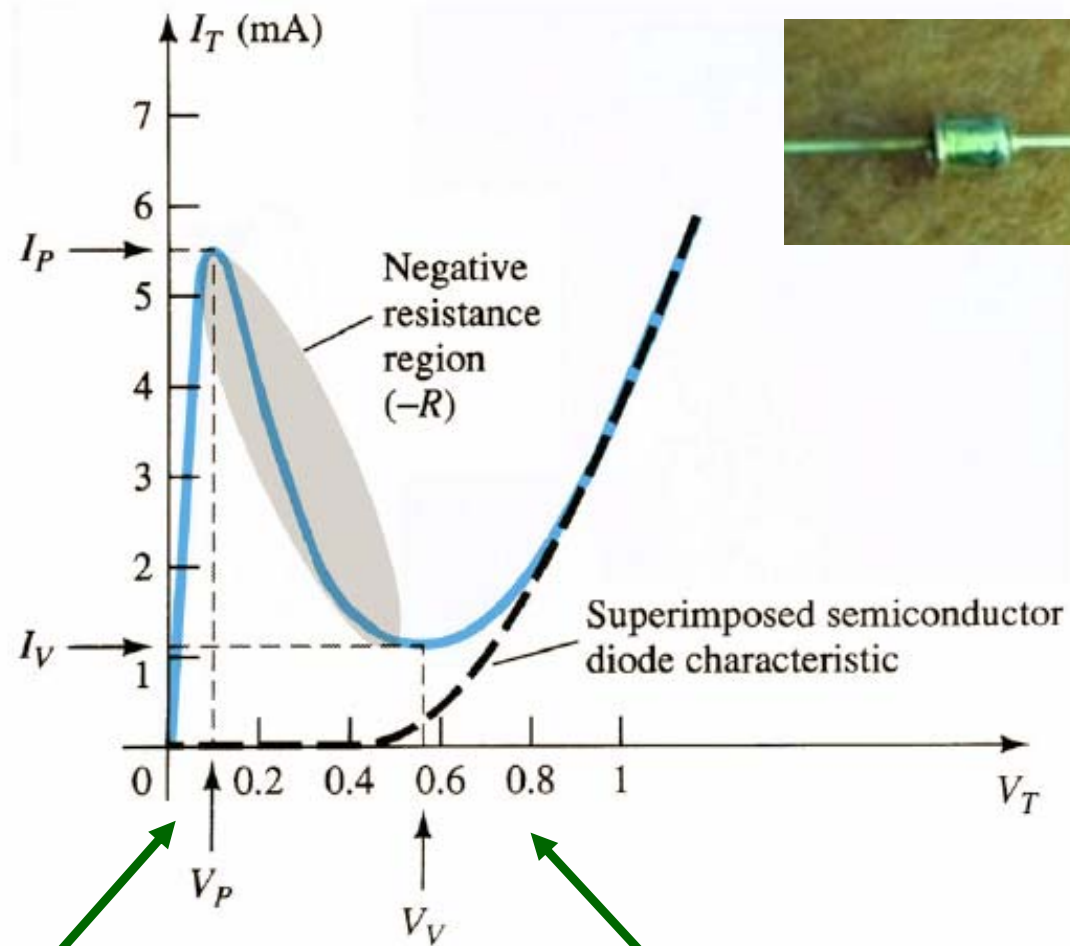
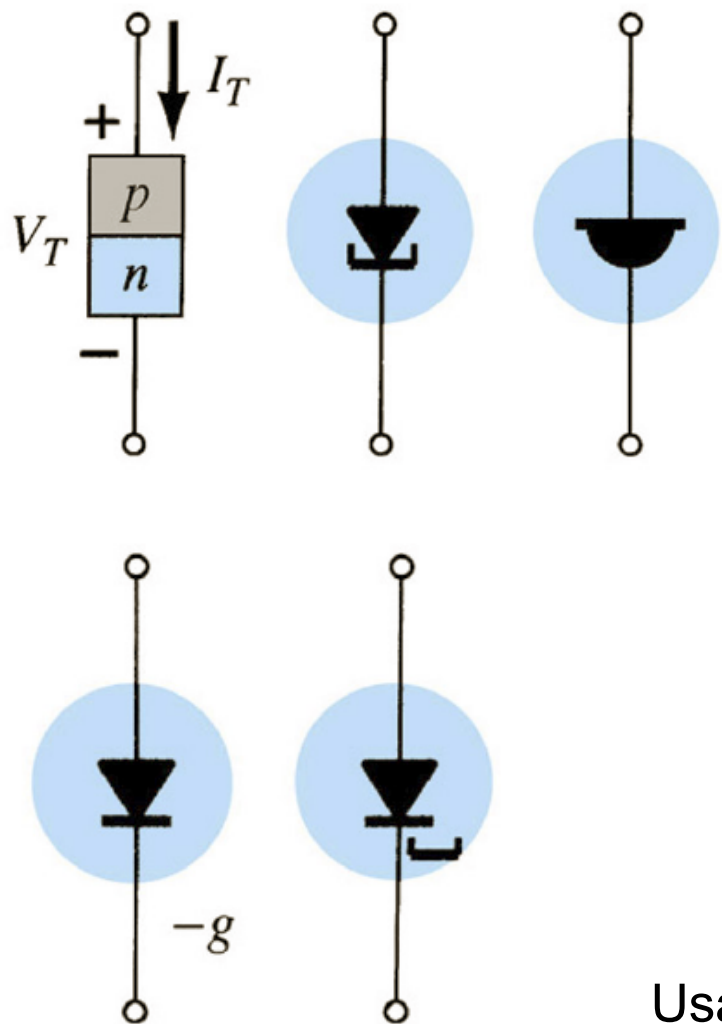
Diodos varactor (varicap)

Varicap:

- São diodos que variam sua capacitância com a tensão aplicada nos seus terminais.



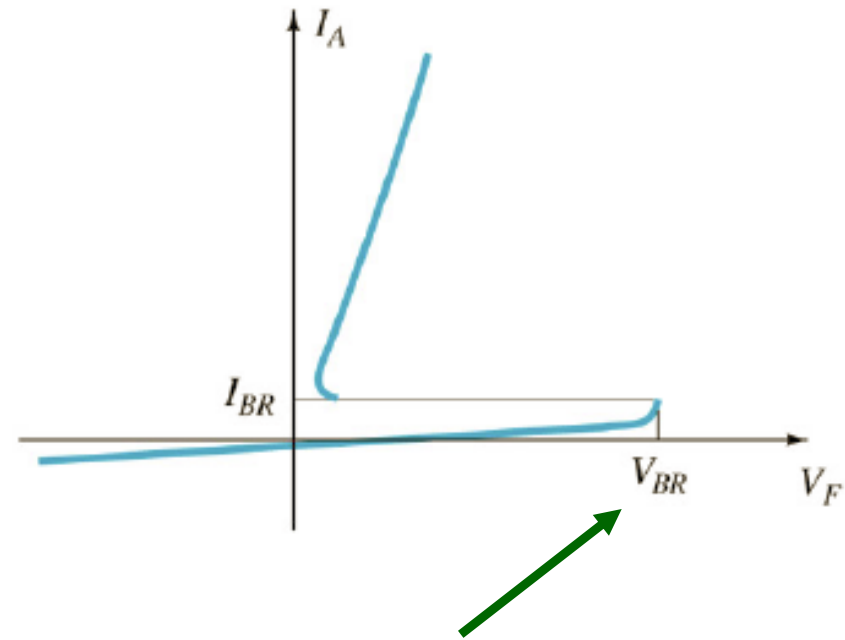
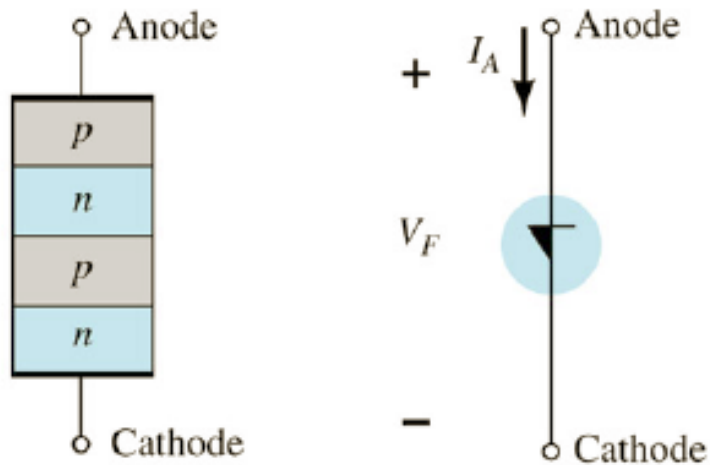
Diodos túnel



Usado em aplicações que requerem alta velocidade de comutação.

Também usado em circuitos osciladores.

Diodo Shockley

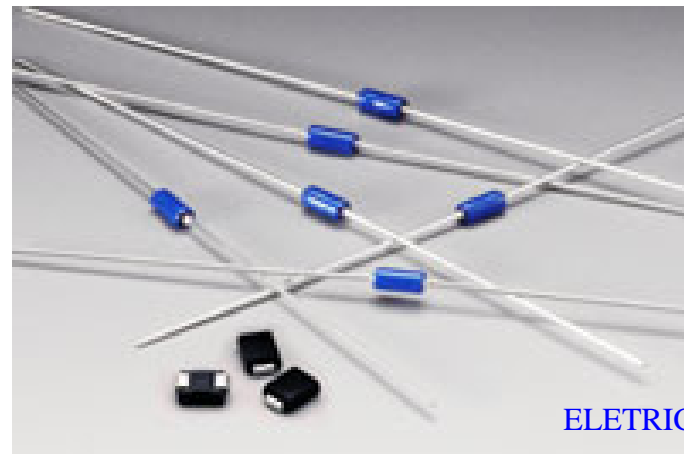
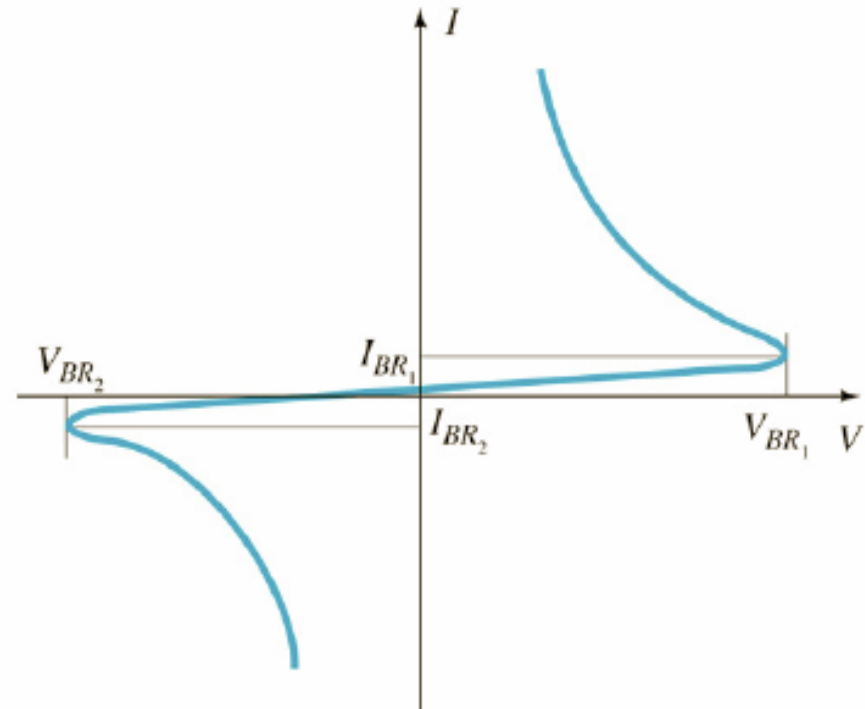
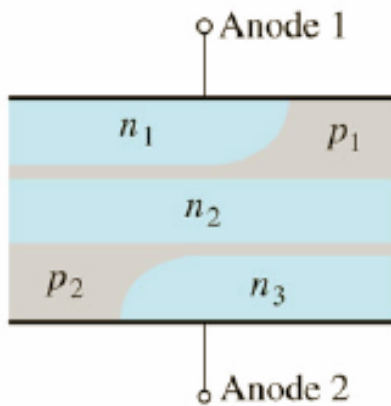
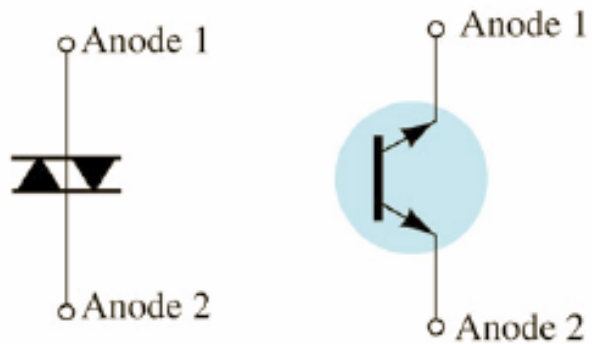


Entra em condução quando é atingida a tensão de ruptura (avalanche).

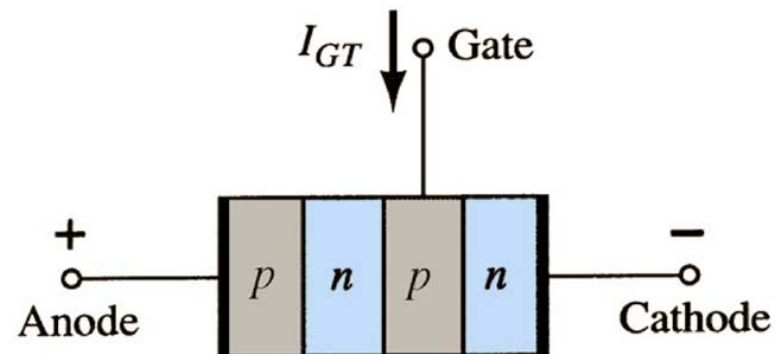
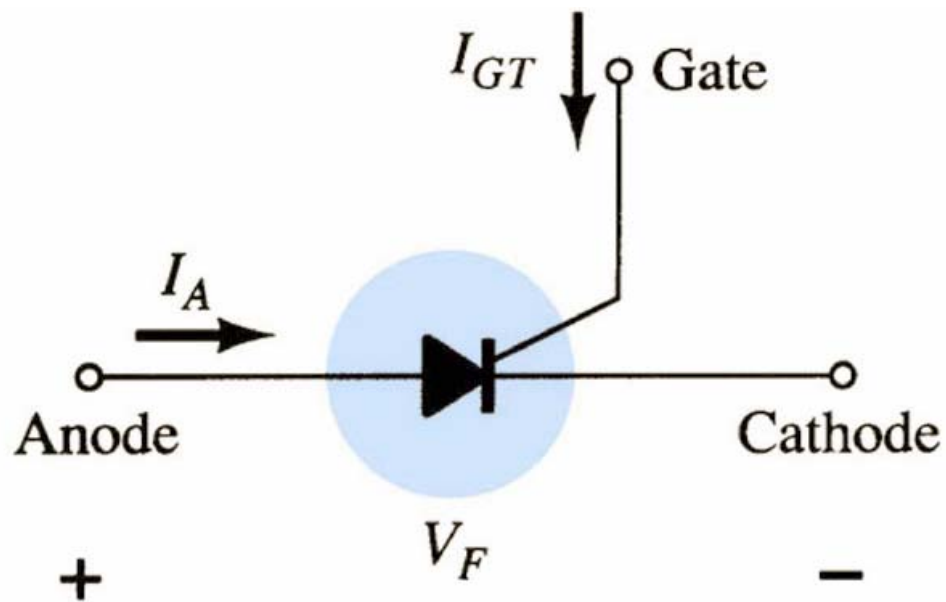


Diac

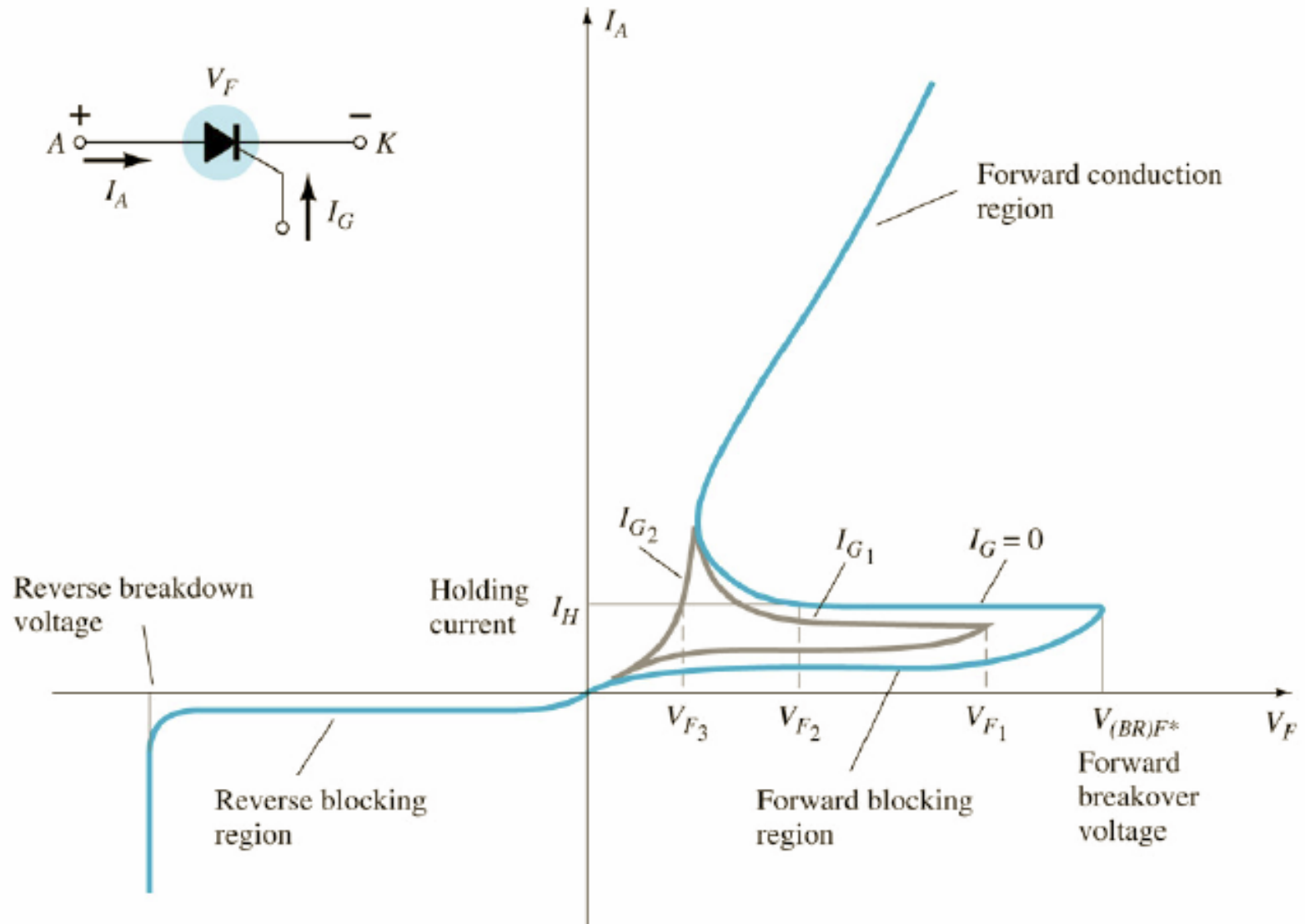
Diac – Diode for alternating current
(Diodo para corrente alternada)



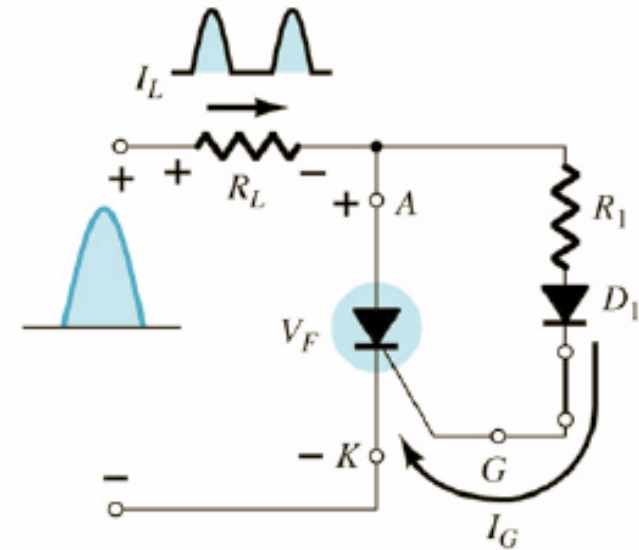
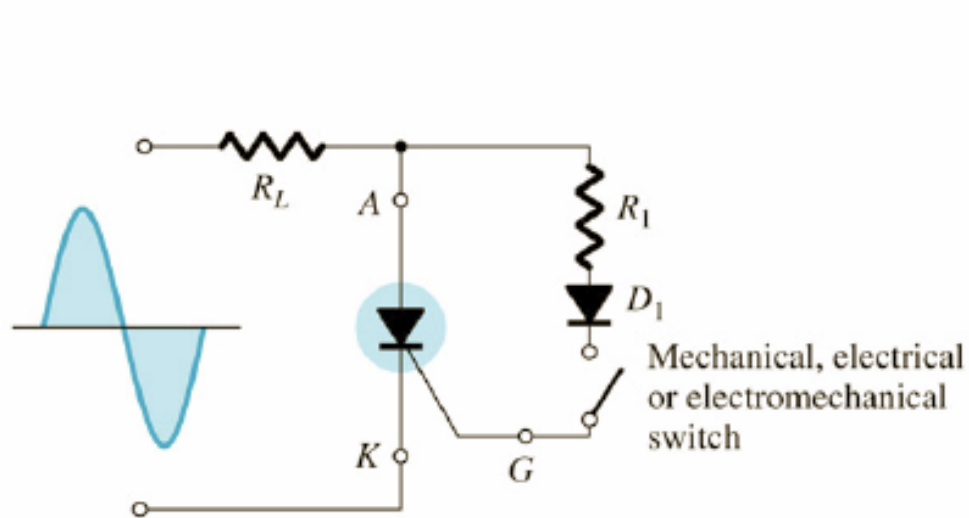
Retificador controlado de silício (SCR)



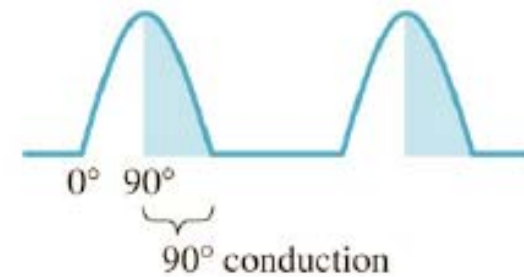
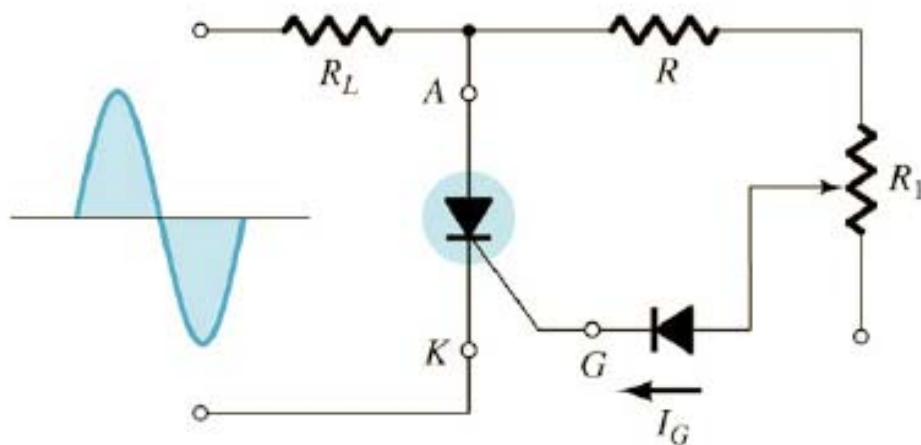
Retificador controlado de silício (SCR)



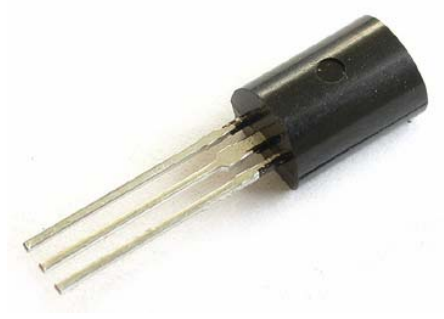
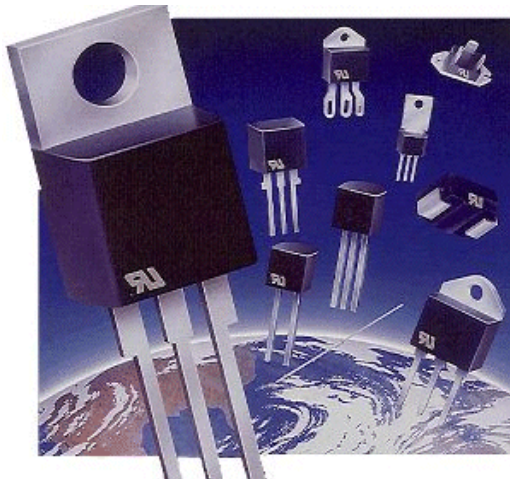
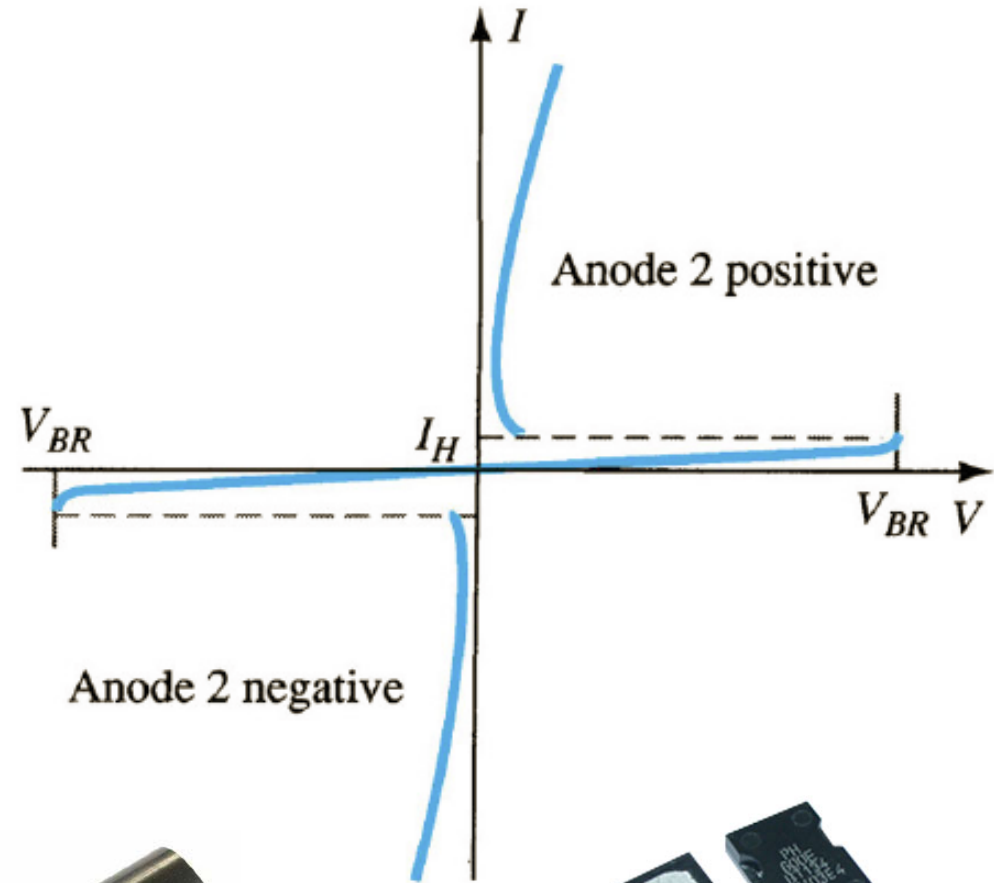
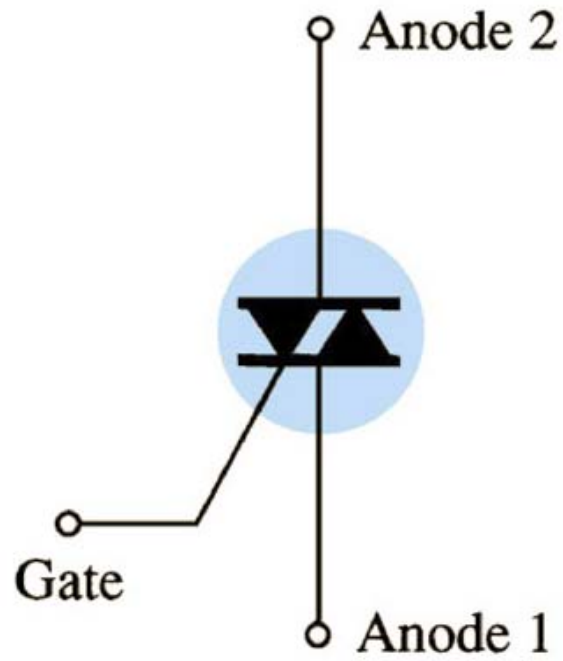
Retificador controlado de silício (SCR)



Retificadores de meia onda controlados.



Triac



Triac

