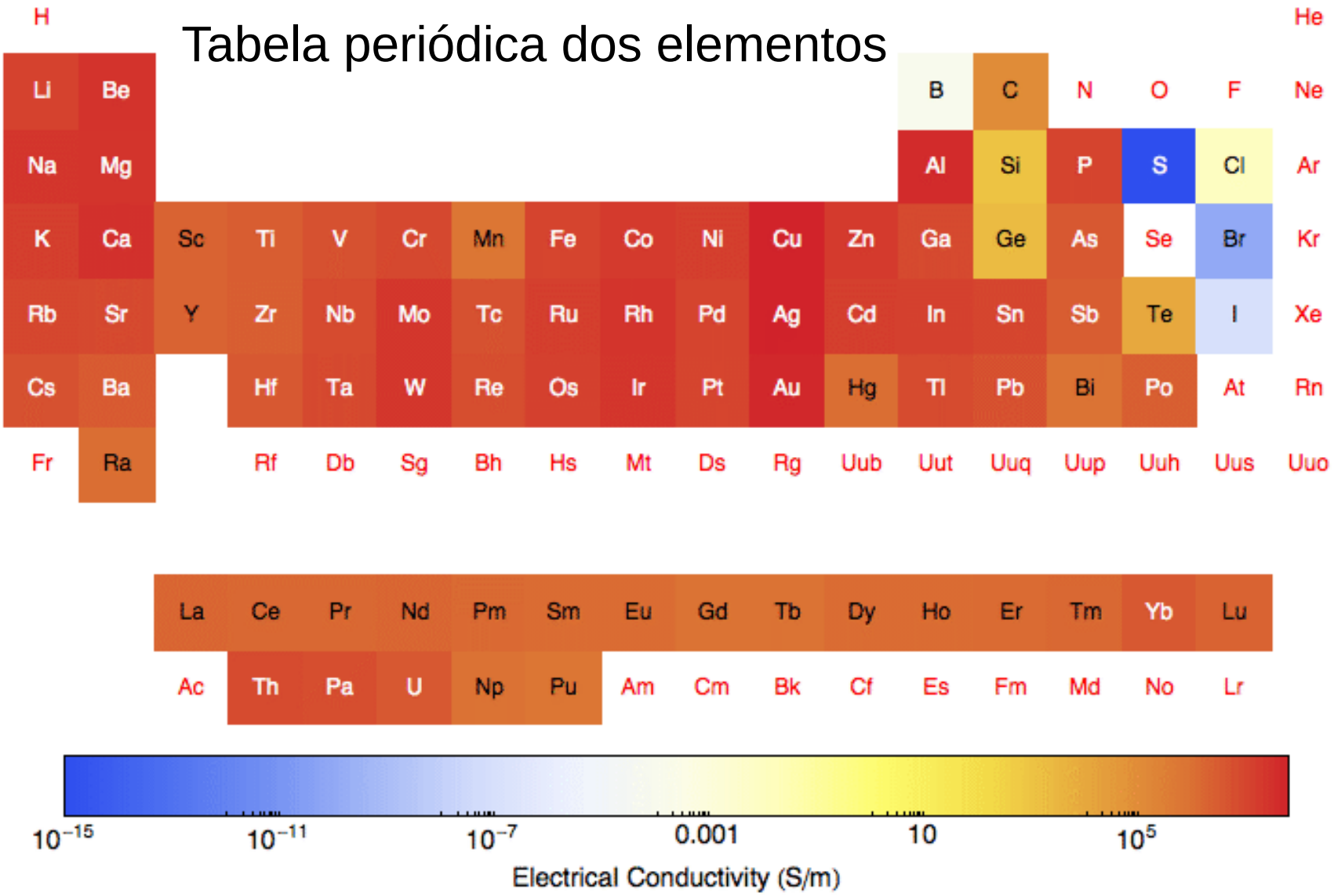
LOM3258 Introdução à Eletrônica e Computação Física

Básico de Eletrônica

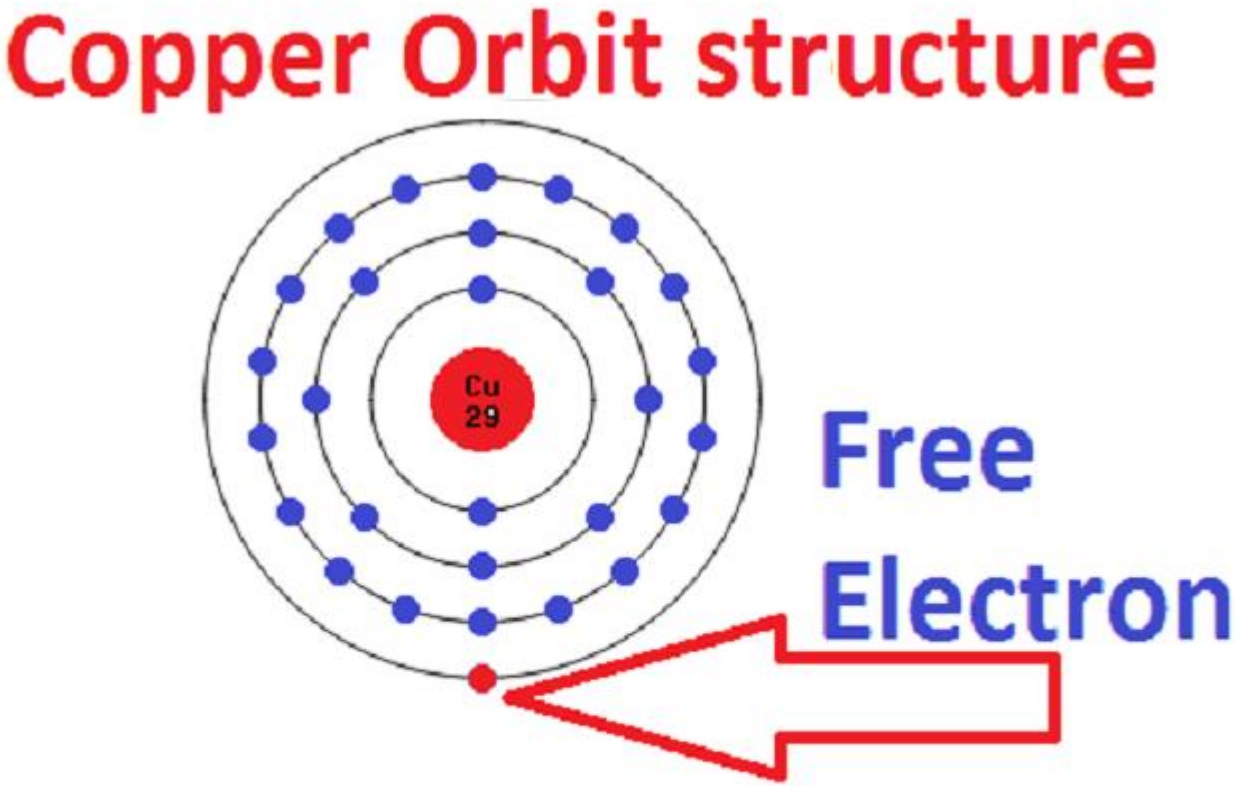
Resistor
Diodo
Transistor

Resistência e condutividade elétrica

Condutividade elétrica dos elementos

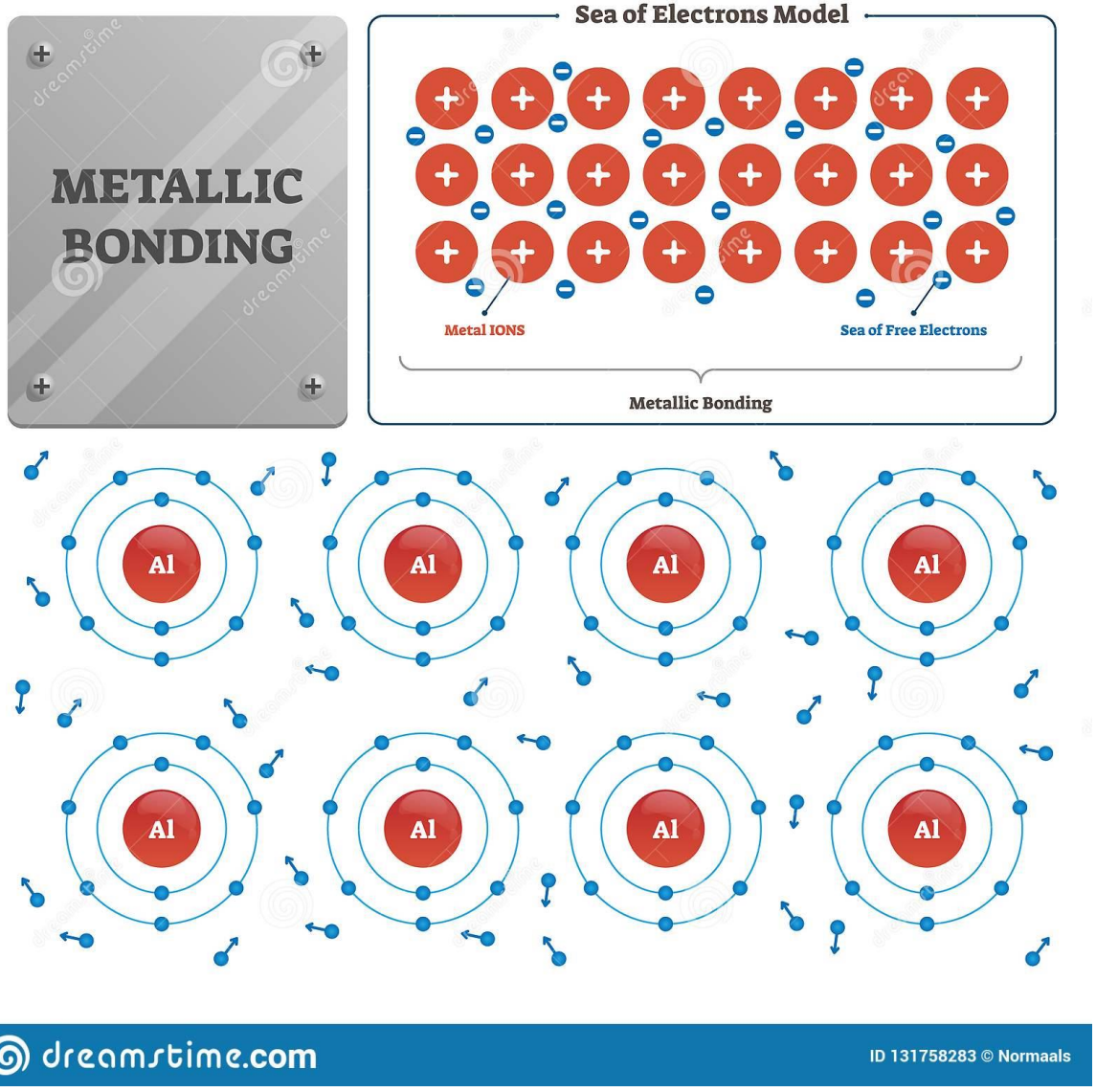


Estrutura eletrônica e condutividade elétrica



k=2, l=8, m= 18, Last =1

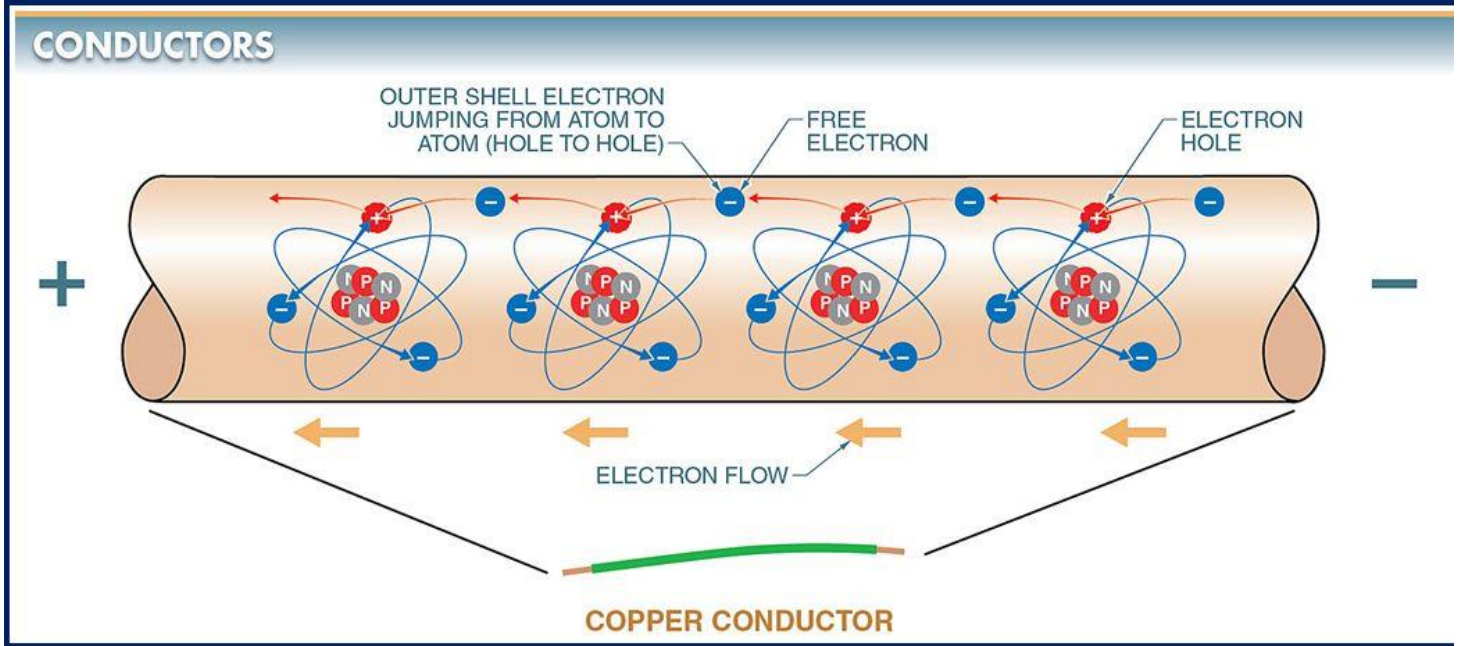
Estrutura eletrônica e condutividade elétrica



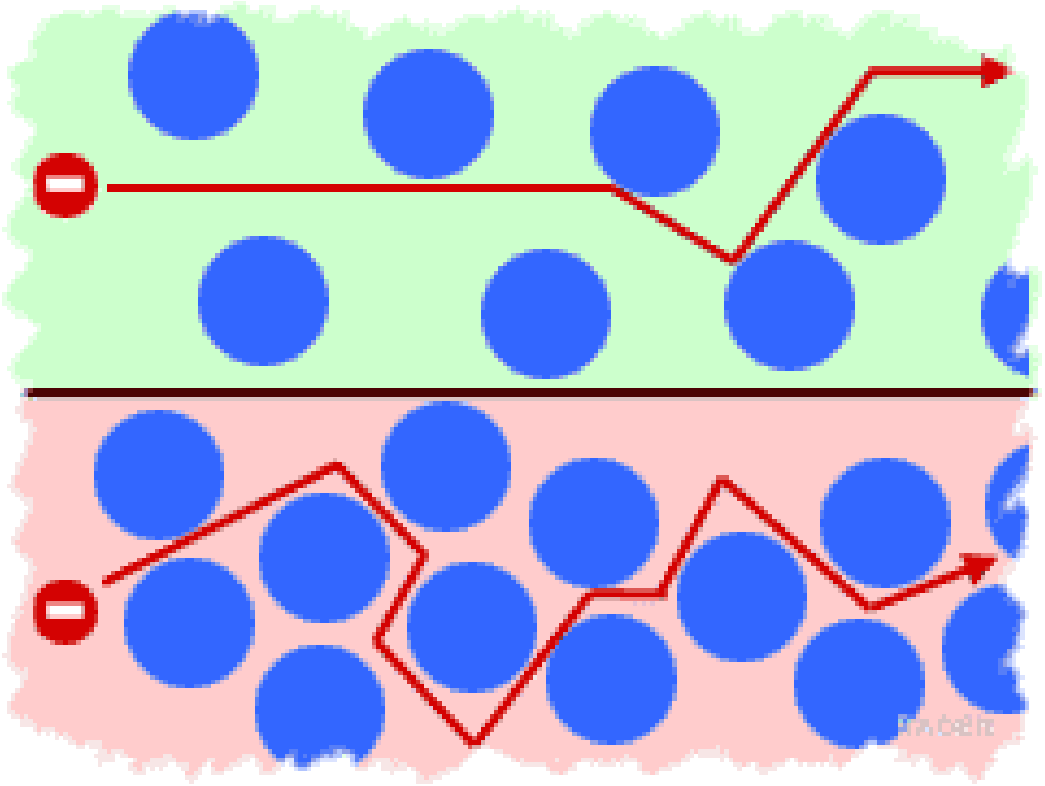
dreamstime.com
ID 131758283 © Normaals

Estrutura eletrônica e condutividade elétrica

A conductor allows free electrons to pass readily through it.



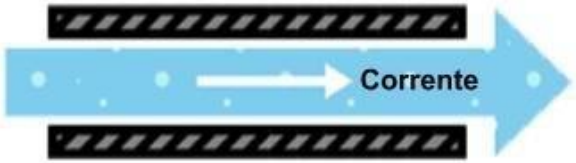
Estrutura eletrônica e condutividade elétrica



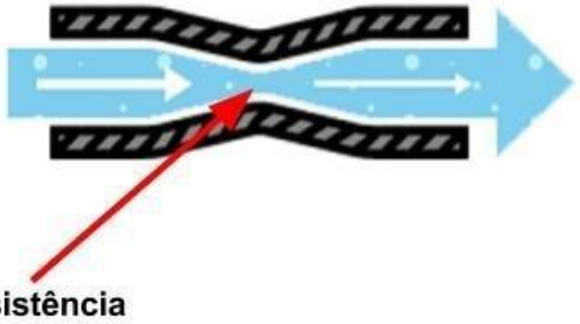
Resistor

Resistor **limita** a corrente

Cano de água
sem resistência permite
corrente máxima.



Cano de água
com resistência que
limita a corrente!



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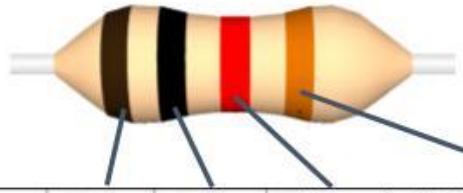
Resistor

Exemplo de valor de resistor



Cor	1ª Faixa	2ª Faixa	Nº de zeros/multiplicador	Tolerância
Preto	0	0	x1	
Marrom	1	1	x10	± 1%
Vermelho	2	2	x100	± 2%
Laranja	3	3	x1.000	
Amarelo	4	4	x10.000	
Verde	5	5	x100.000	± 0,5%
Azul	6	6	x1.000.000	± 0,25%
Violeta	7	7	x10.000.000	± 0,1%
Cinza	8	8	x100.000.000	± 0,05%
Branco	9	9	x1.000.000.000	
Dourado			x0,1	± 5%
Prata			x0,01	± 10%

4 faixas de cores

1ª faixa: MARROM = 1
2ª faixa: PRETO = 0
3ª faixa (multiplicador): VERMELHO = x100
4ª faixa (tolerância): DOURADO: 5%

10 x 100 = 1000 ohms

Resistor de 1000 Ohms com 5% de tolerância

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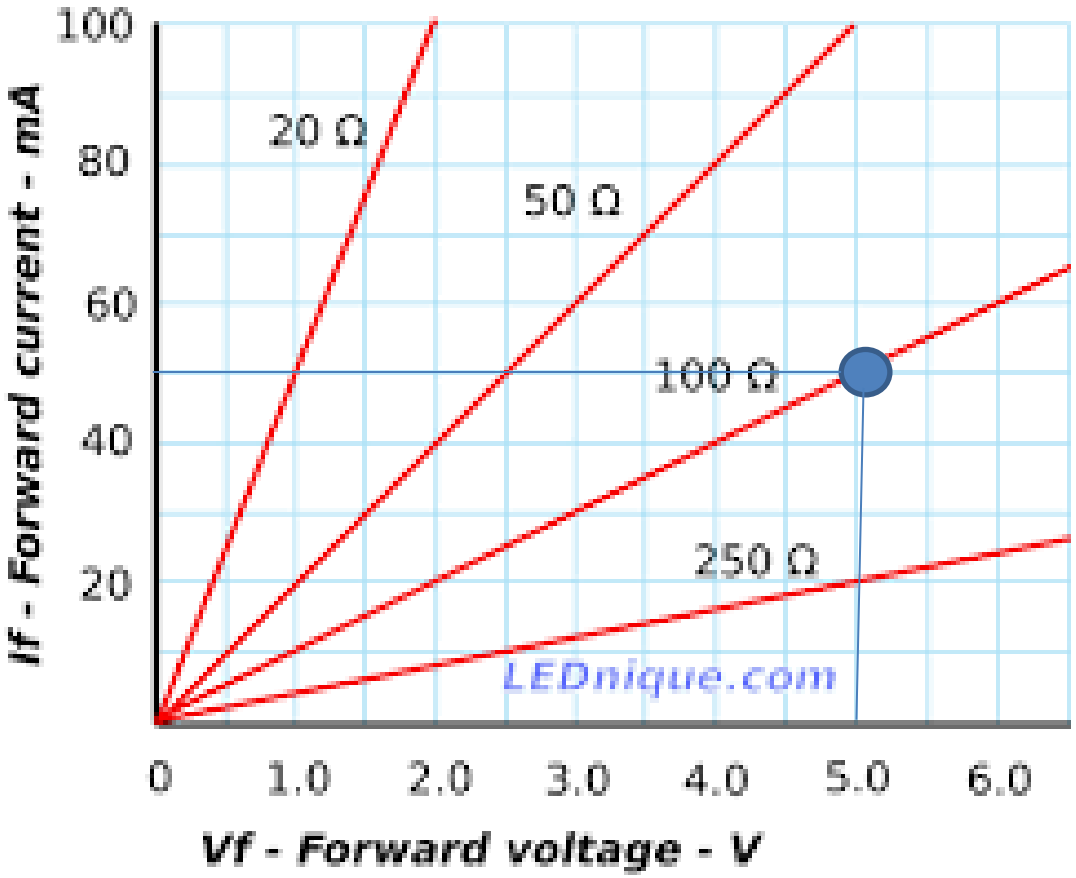
Curva tensão vs. corrente de resistor



$$V = RI$$

$$I = V / R$$

$$R = \Delta V / \Delta I$$

$$1/R = \Delta I / \Delta V$$

Usos do resistor

- Limitação de corrente
- Dissipação de potência (eletricidade)
- Polarização de circuito (eletrônica)

Eletricidade: aplicações de potência (I > 1 A)

Tecnologia de energia

Eletrônica: aplicações de baixa corrente (I < 1 A)

Tecnologia de informação

Resistor

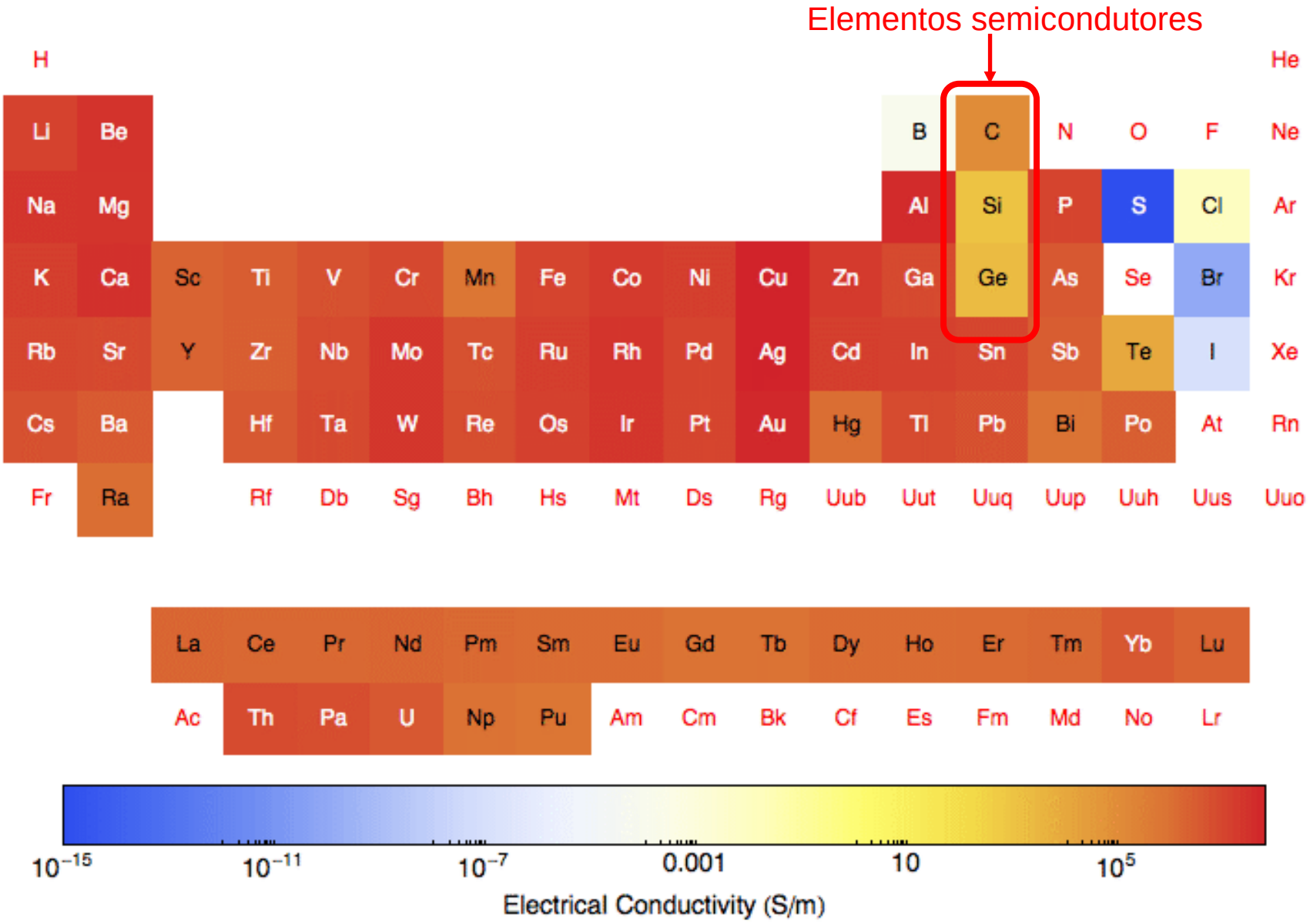
Símbolos de um resistor

IEEE Institute of Electrical and Electronics Engineers

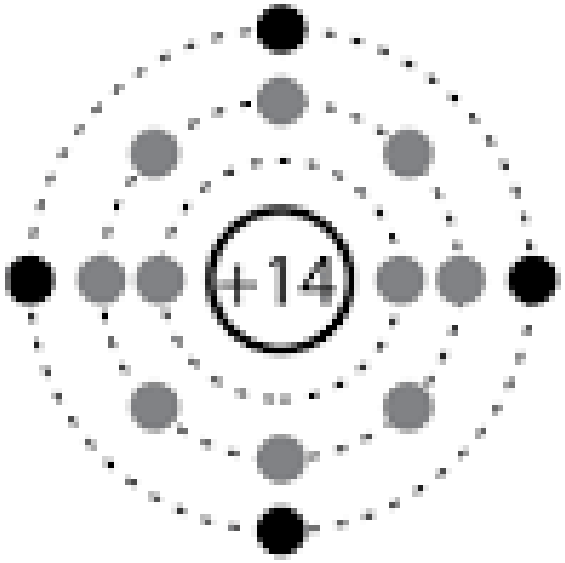
IEC International Electrotechnical Commission

MUNDO DA ELÉTRICA

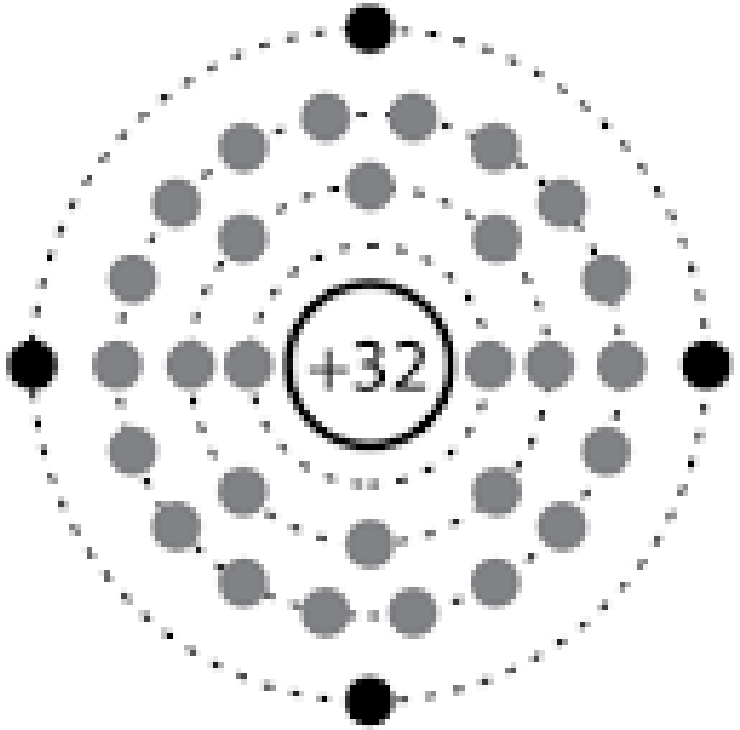
Condutividade elétrica dos elementos



Ementos semicondutores intrínsecos: silício e germânio

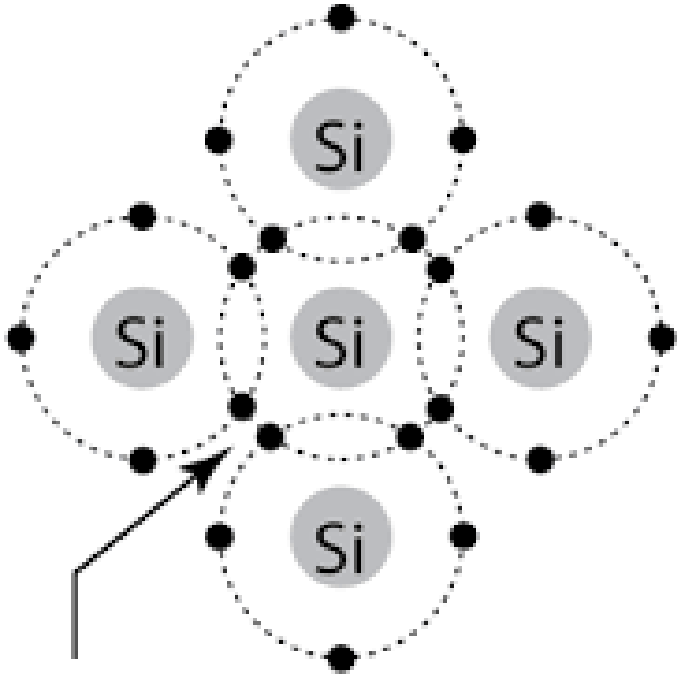


Silicon

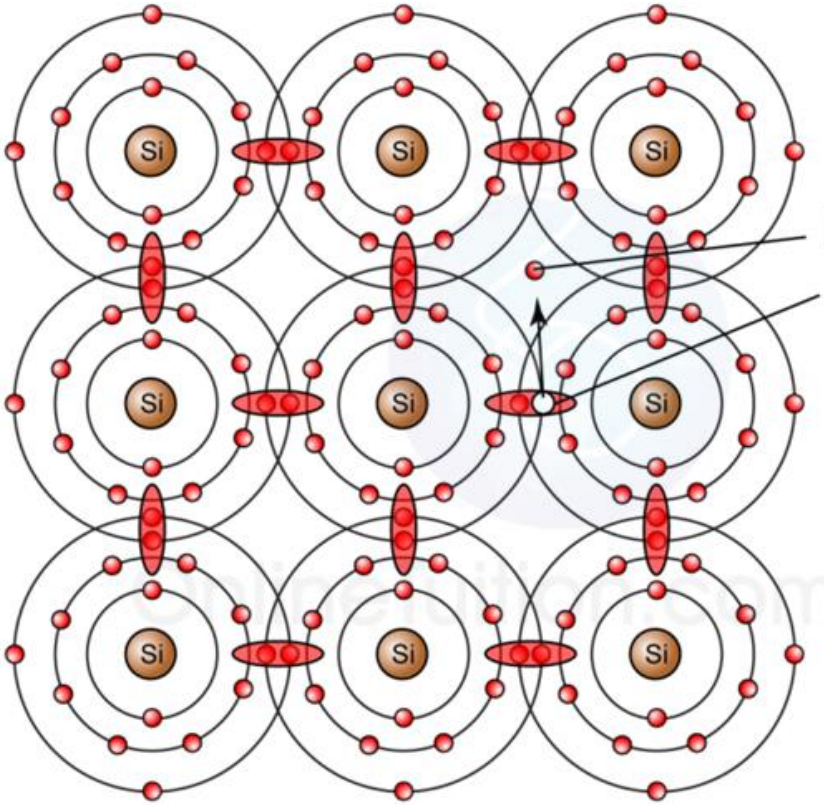


Germanium

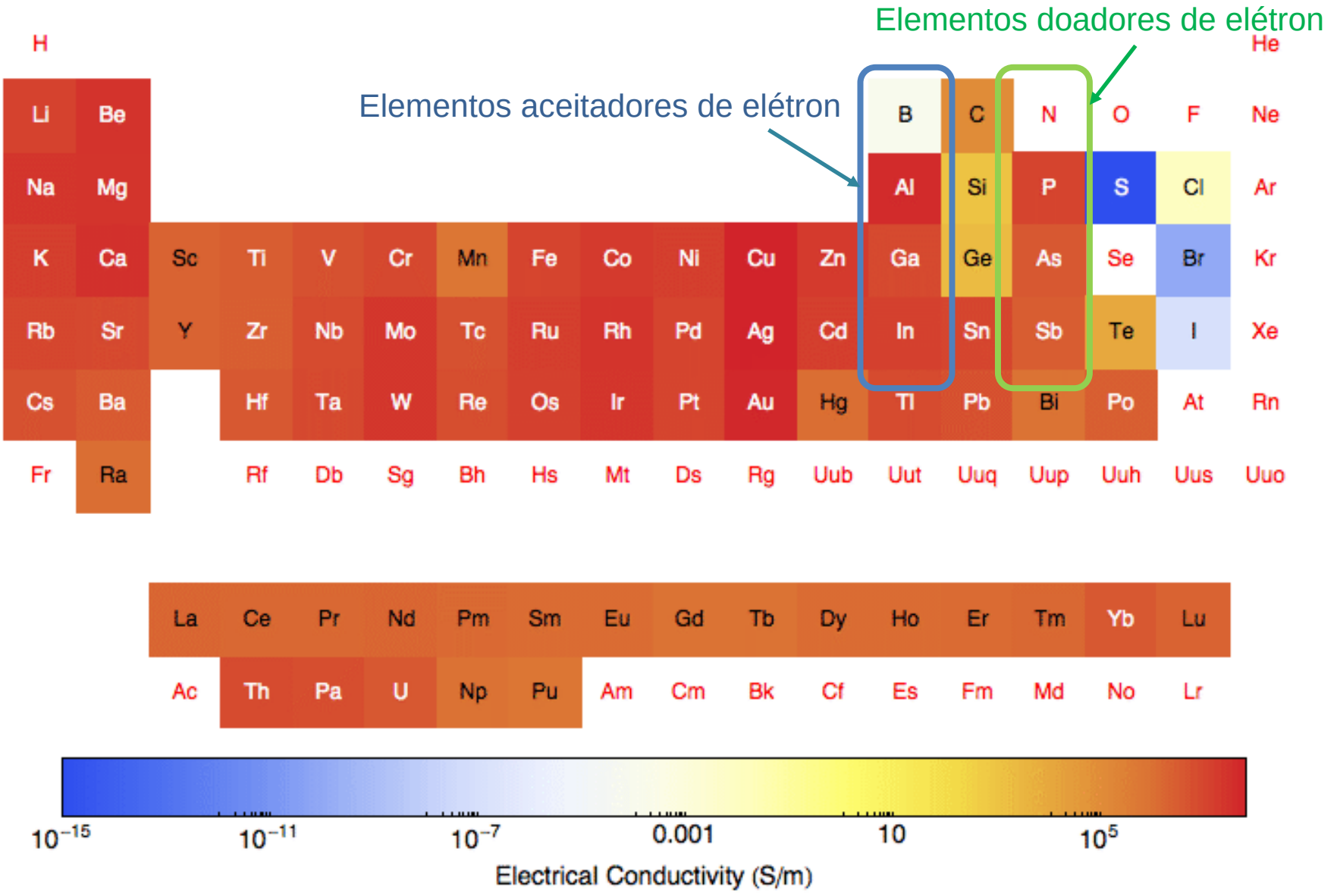
Silício semicondutor intrínseco



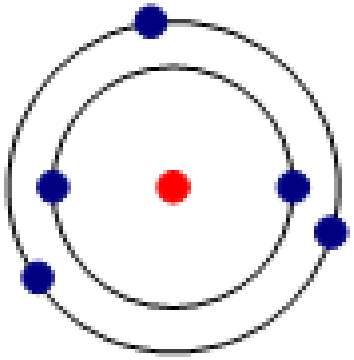
Shared electrons of a covalent bond.



Condutividade elétrica dos elementos

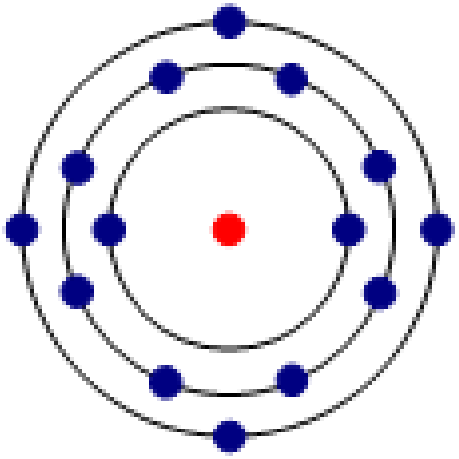


Elementos Boro, Silício e Fósforo



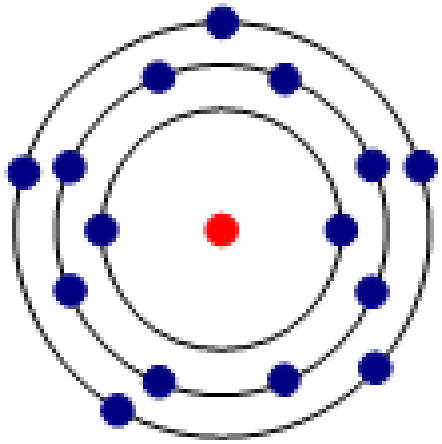
Boron: 5p 6n 5e

3 valence electrons



Silicon: 14p 14n 14e

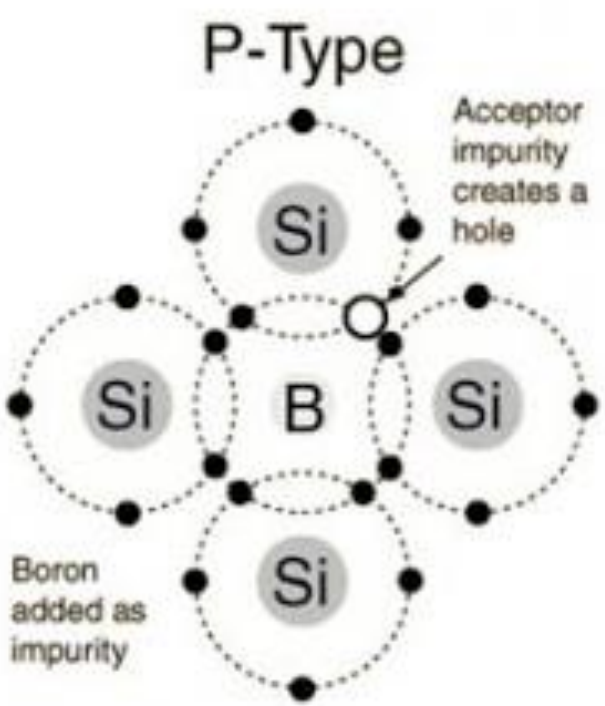
4 valence electrons



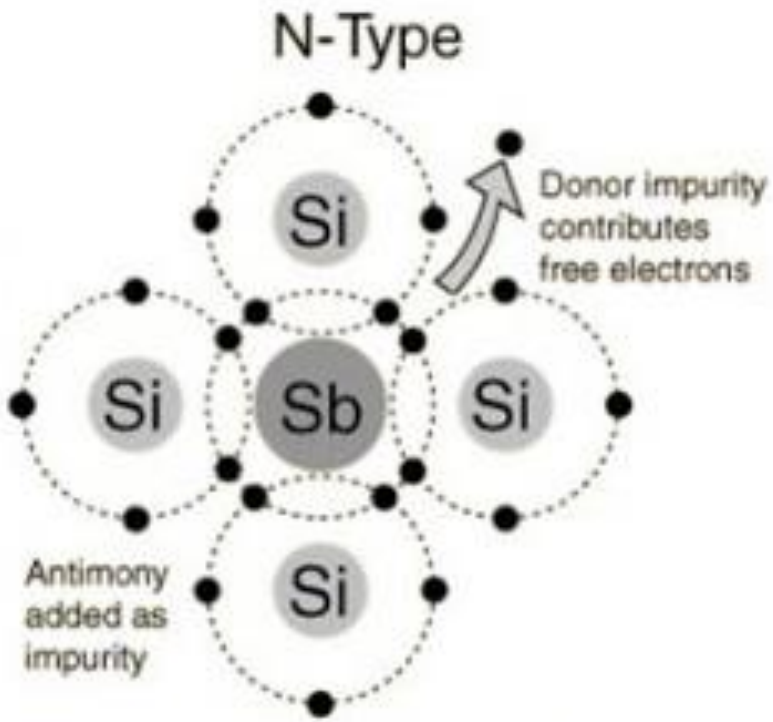
Phosphorus: 15p 15n 15e

5 valence electrons

Silício semicondutor extrínseco

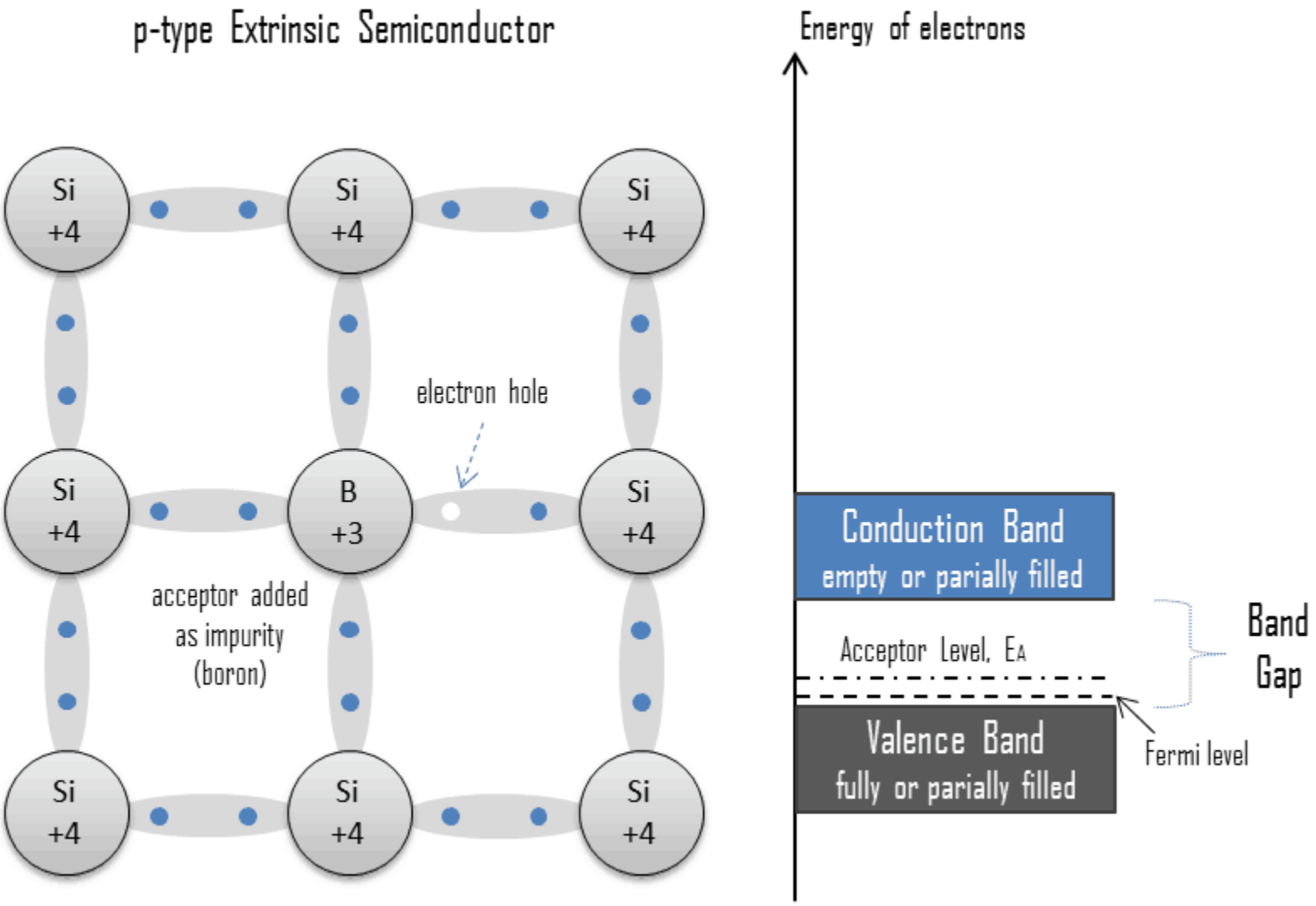


- The P- has a surplus of holes.

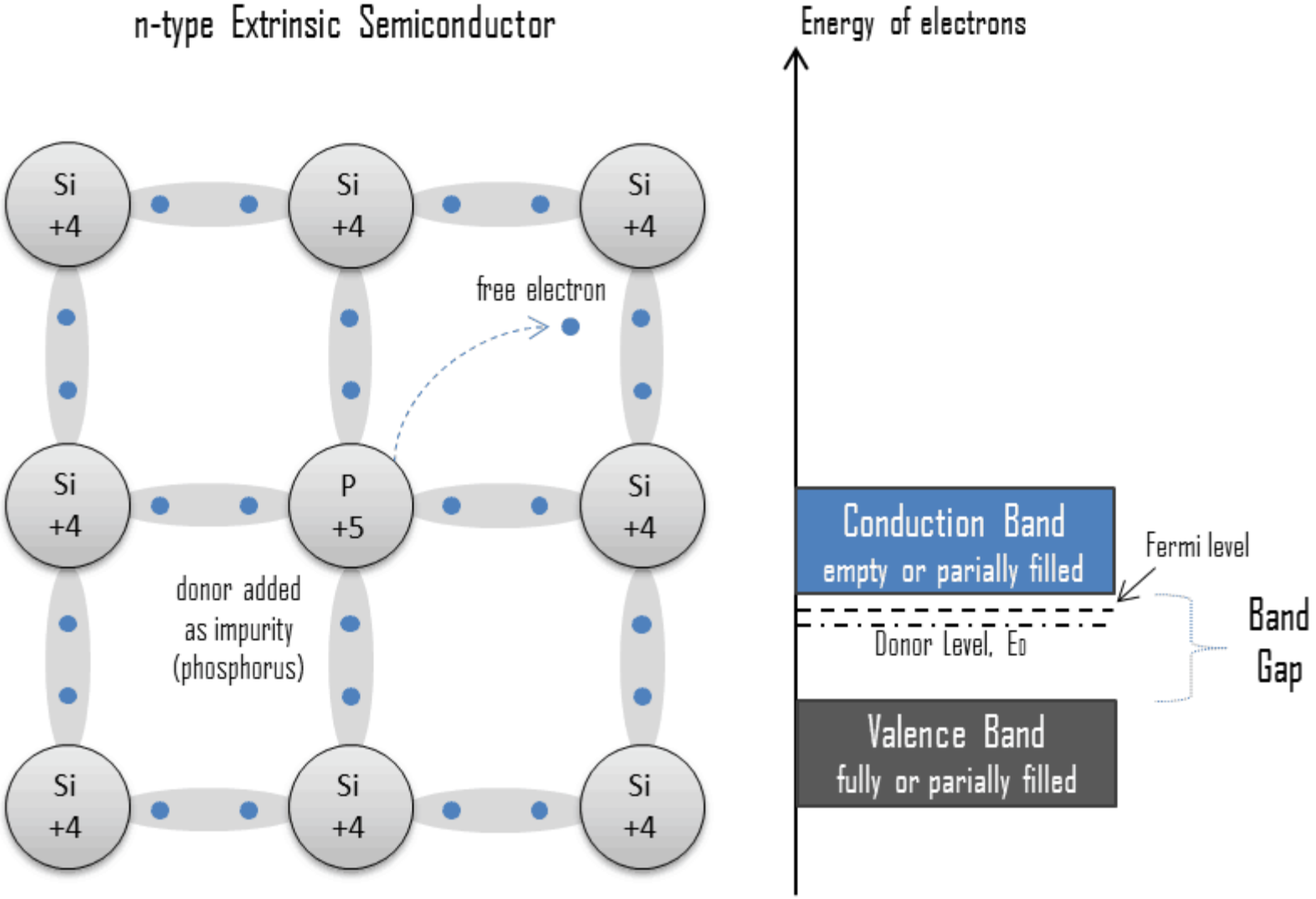


- The N- has a surplus of negative electrons.

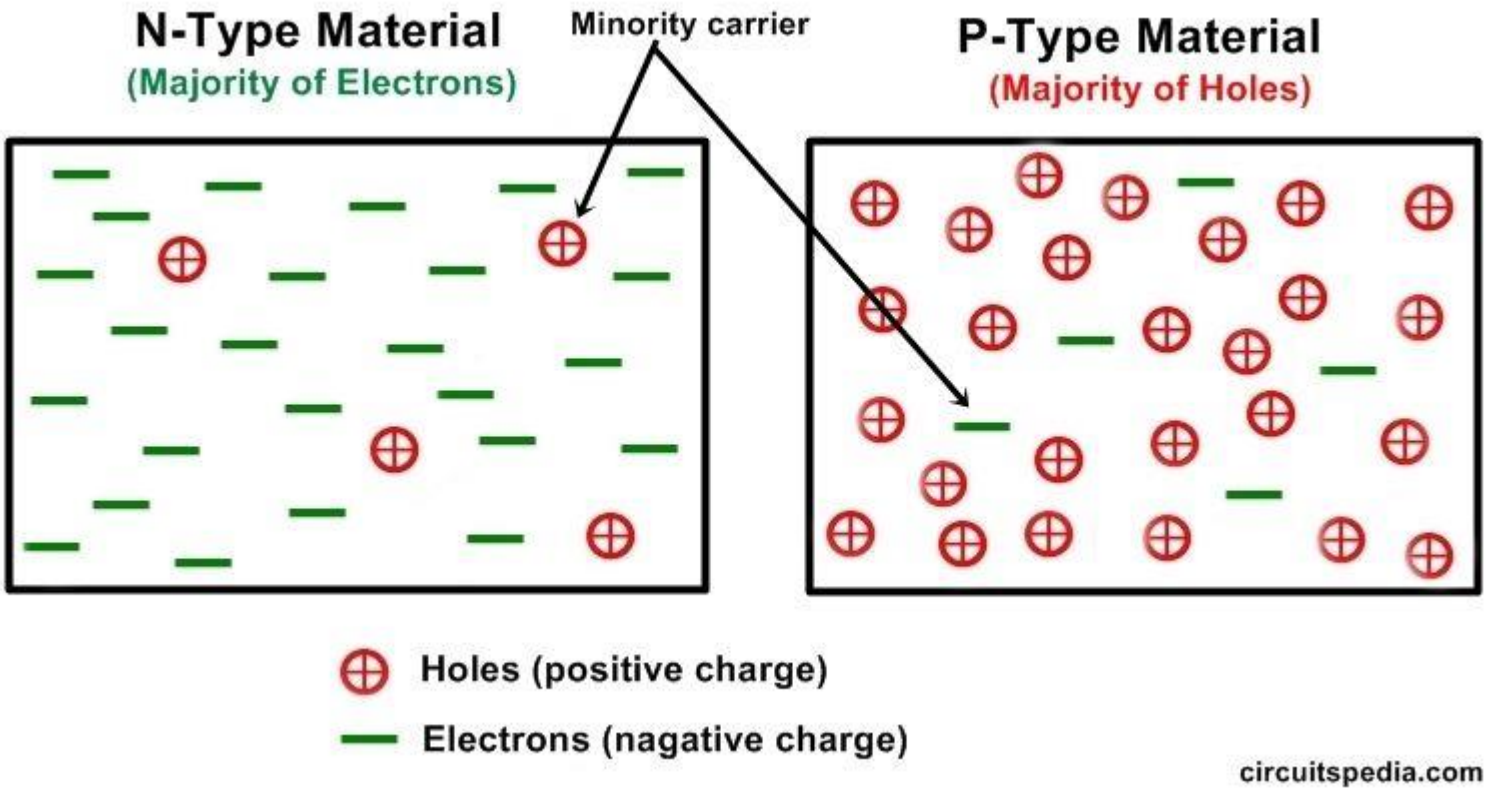
Silício semicondutor extrínseco tipo P



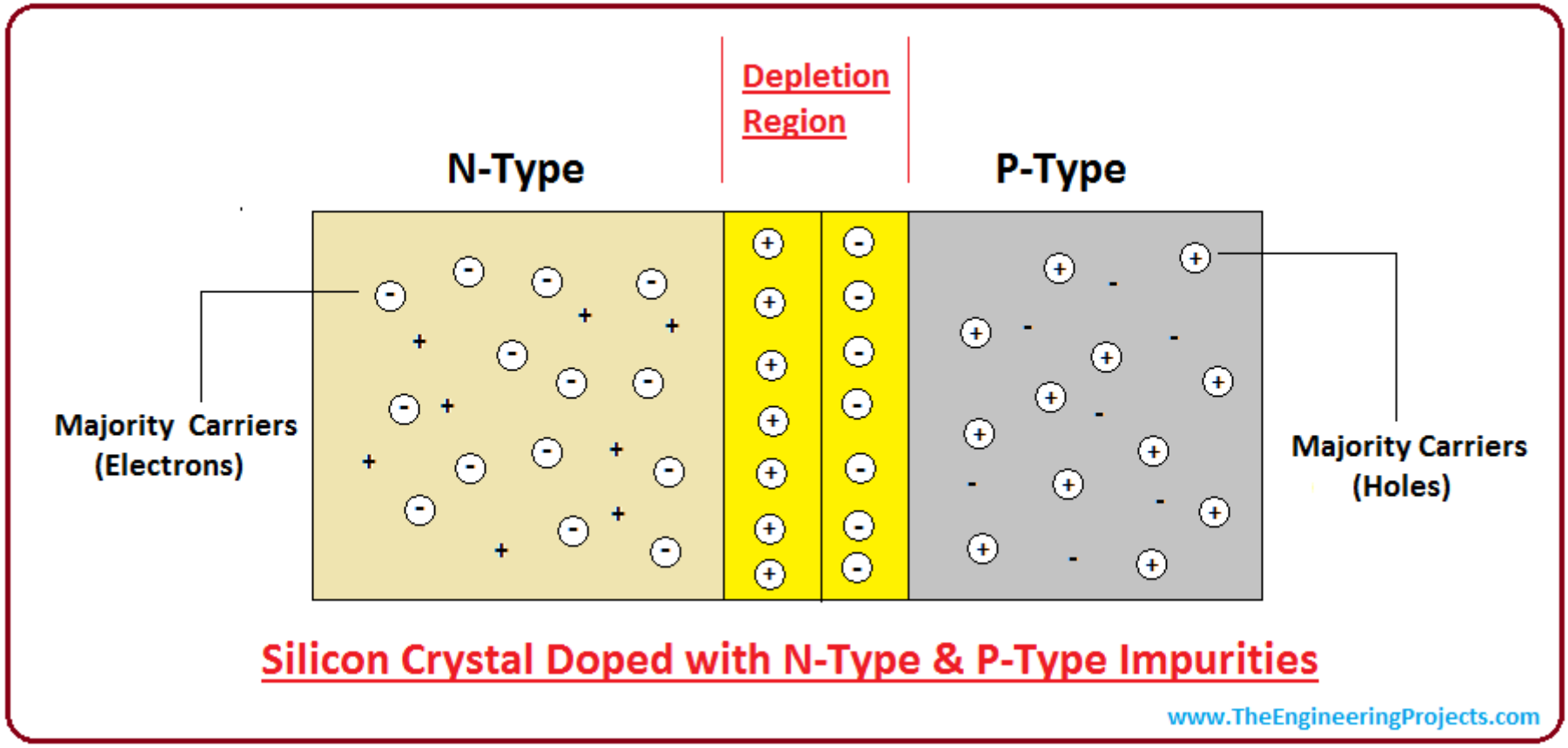
Silício semicondutor extrínseco tipo N



Semicondutores tipo N e P

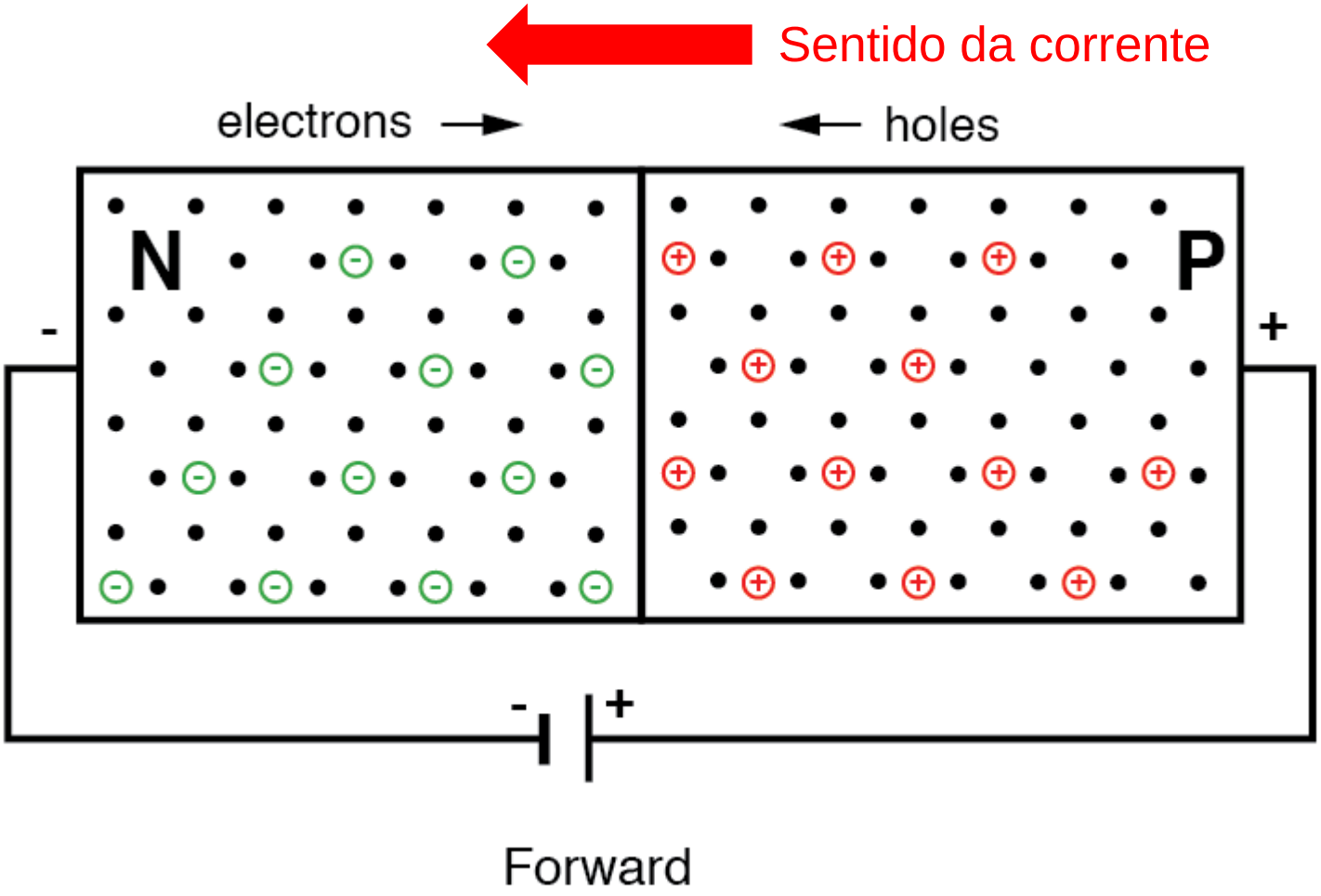


Junção de semicondutores tipo N e P



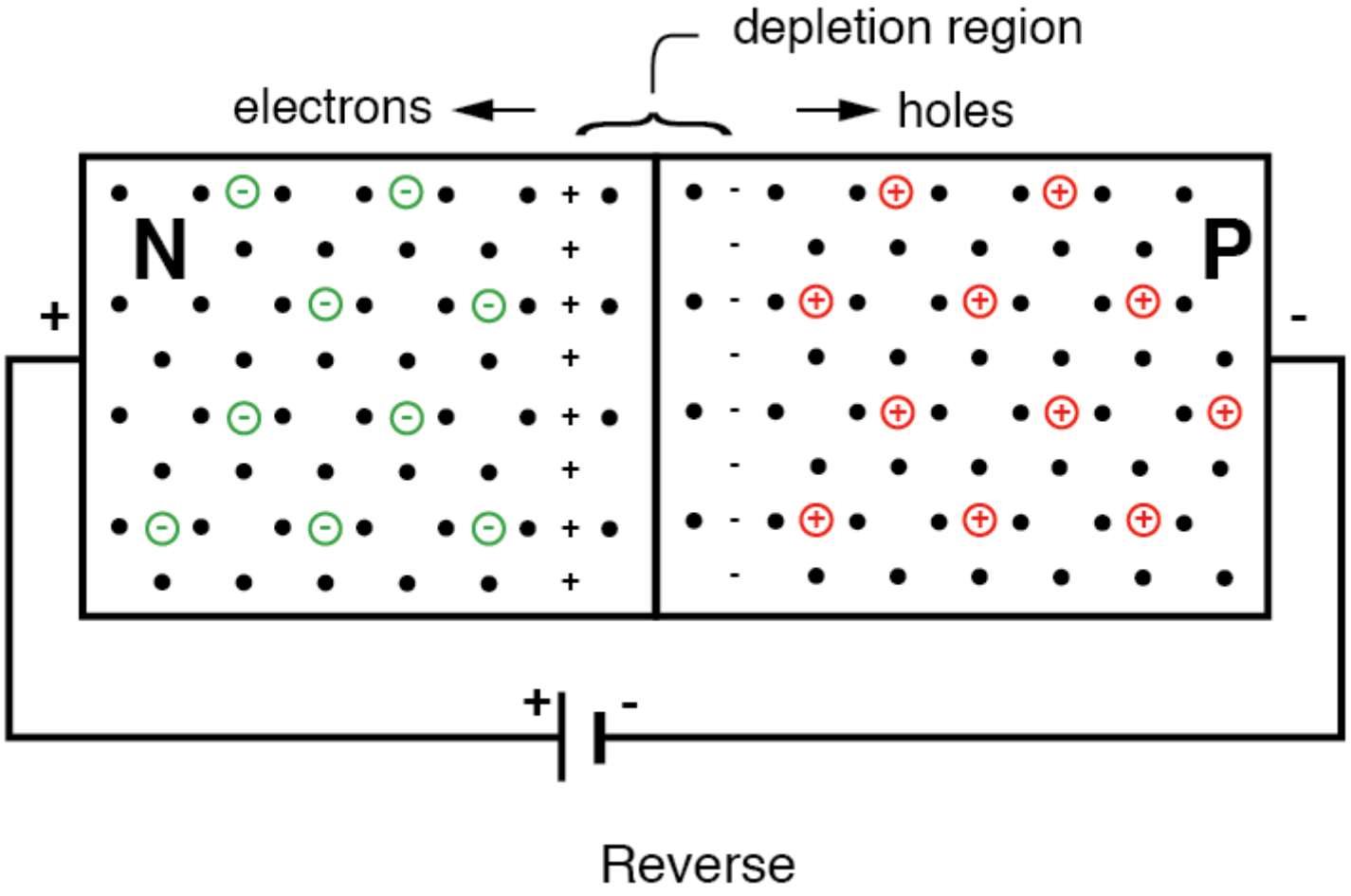
Polarização de diodo de junção PN

Polarização direta: condução de corrente

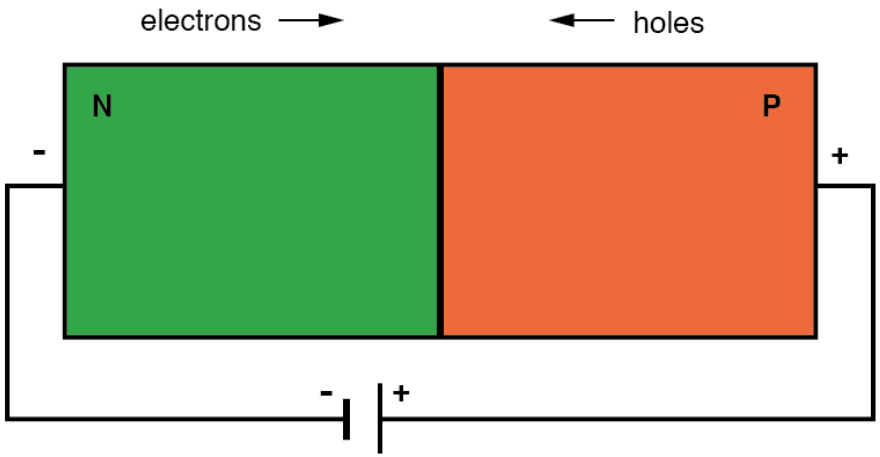


Polarização de diodo de junção PN

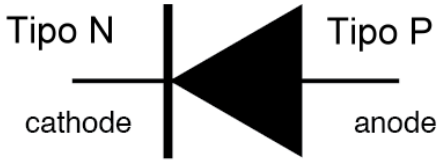
Polarização reversa: bloqueio da corrente

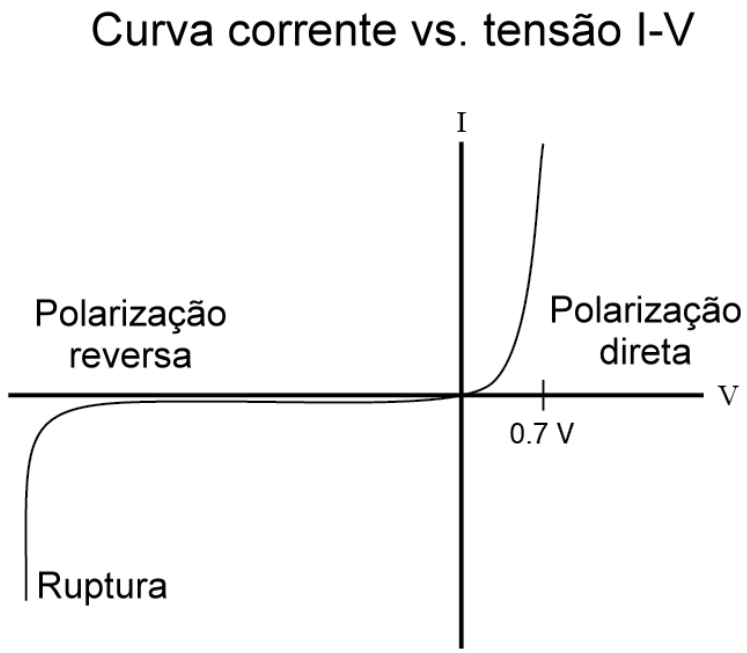


Curva de polarização de diodo de junção PN

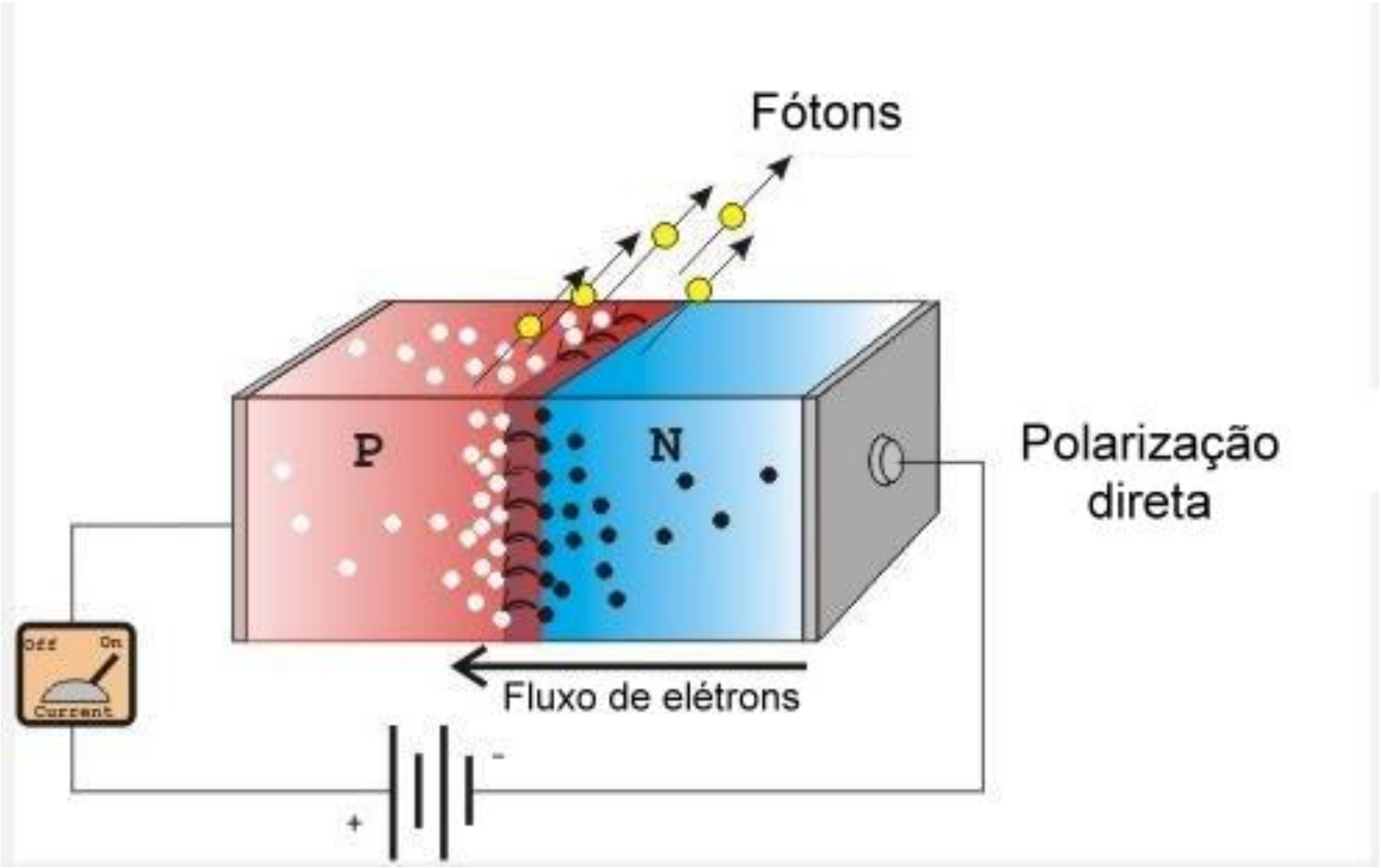


Símbolo

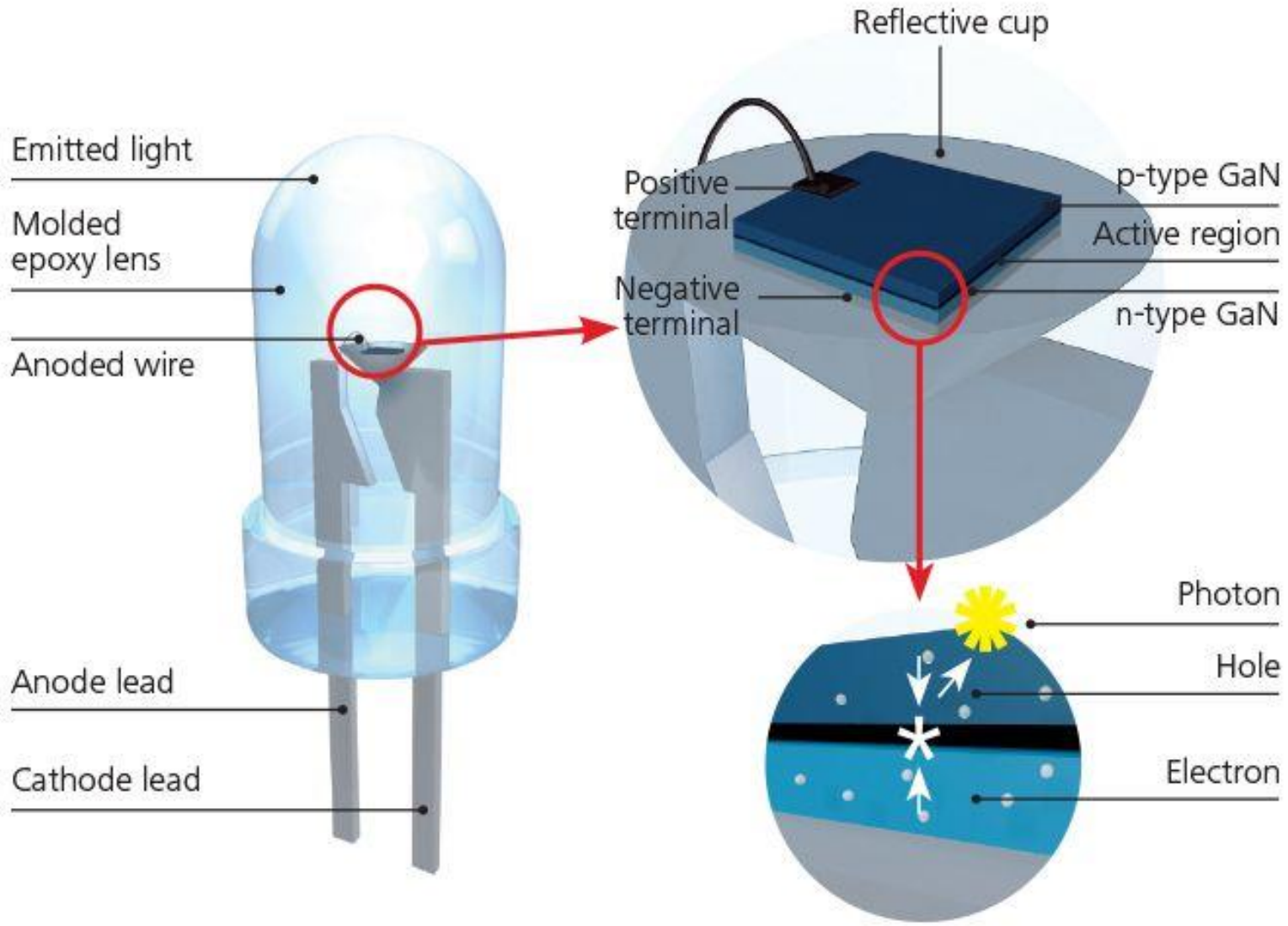




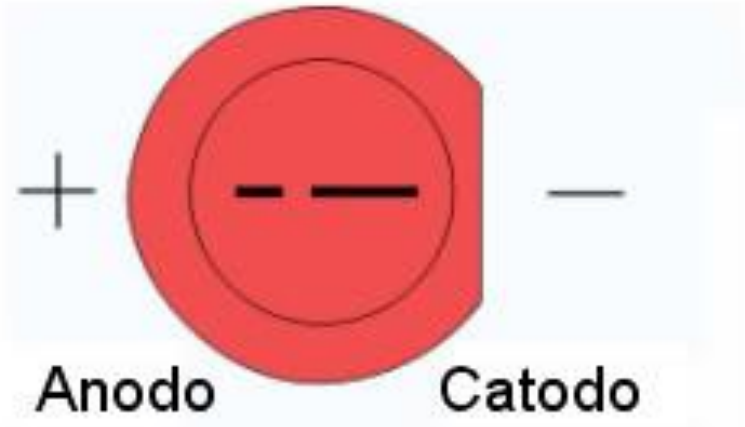
Diodo emissor de luz (LED)

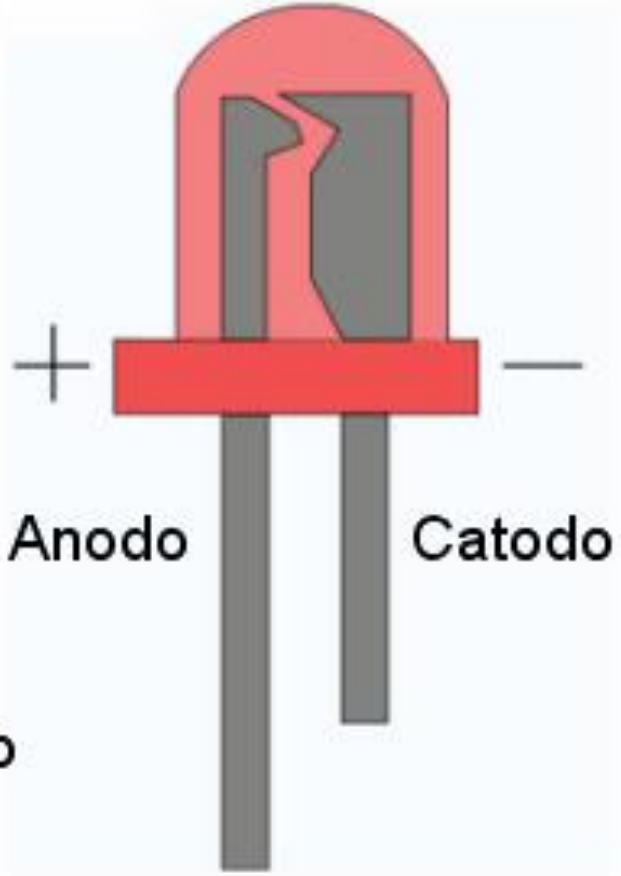


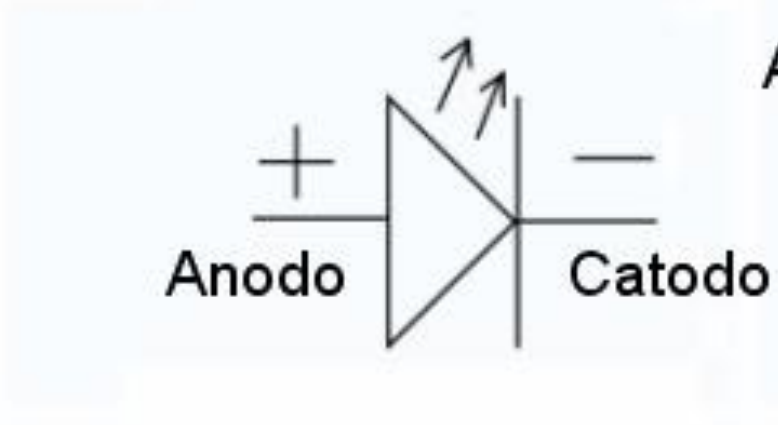
Diodo emissor de luz (LED)



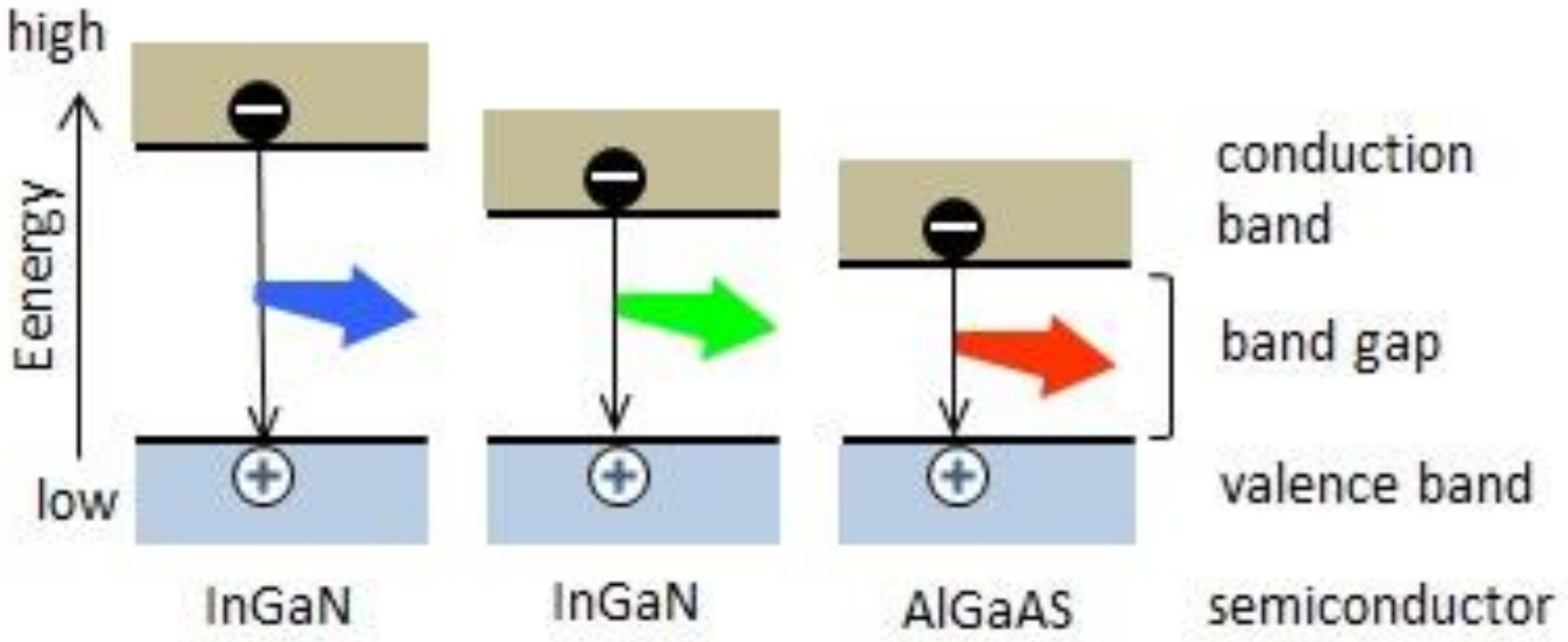
Diodo emissor de luz (LED)



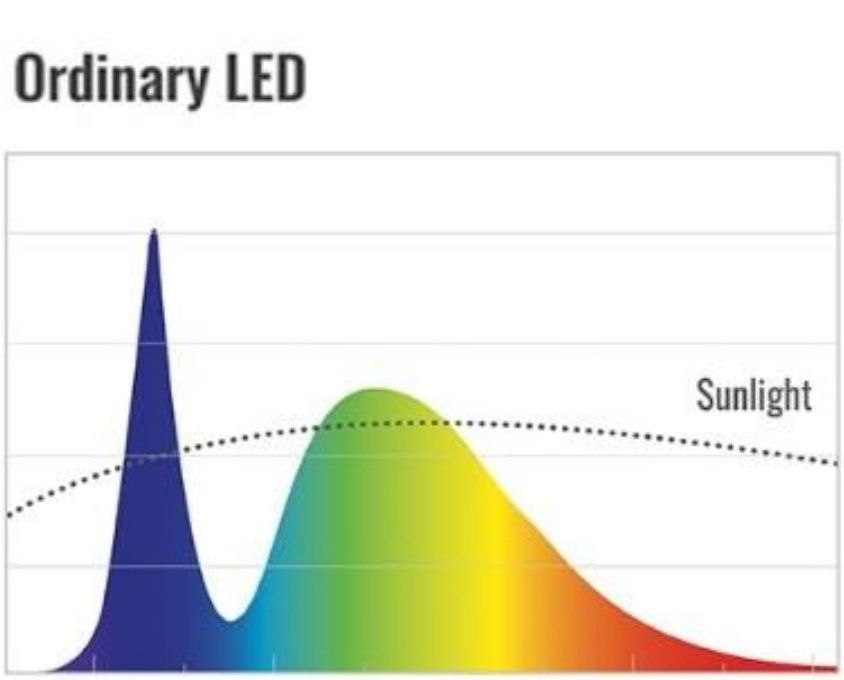


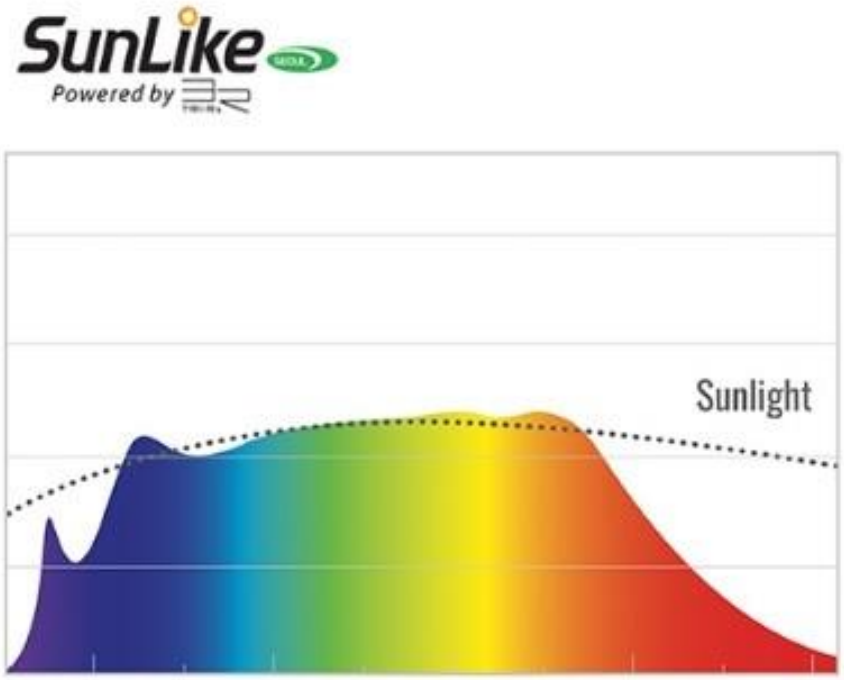


Diodo emissor de luz (LED)



Espectro de emissão do LED

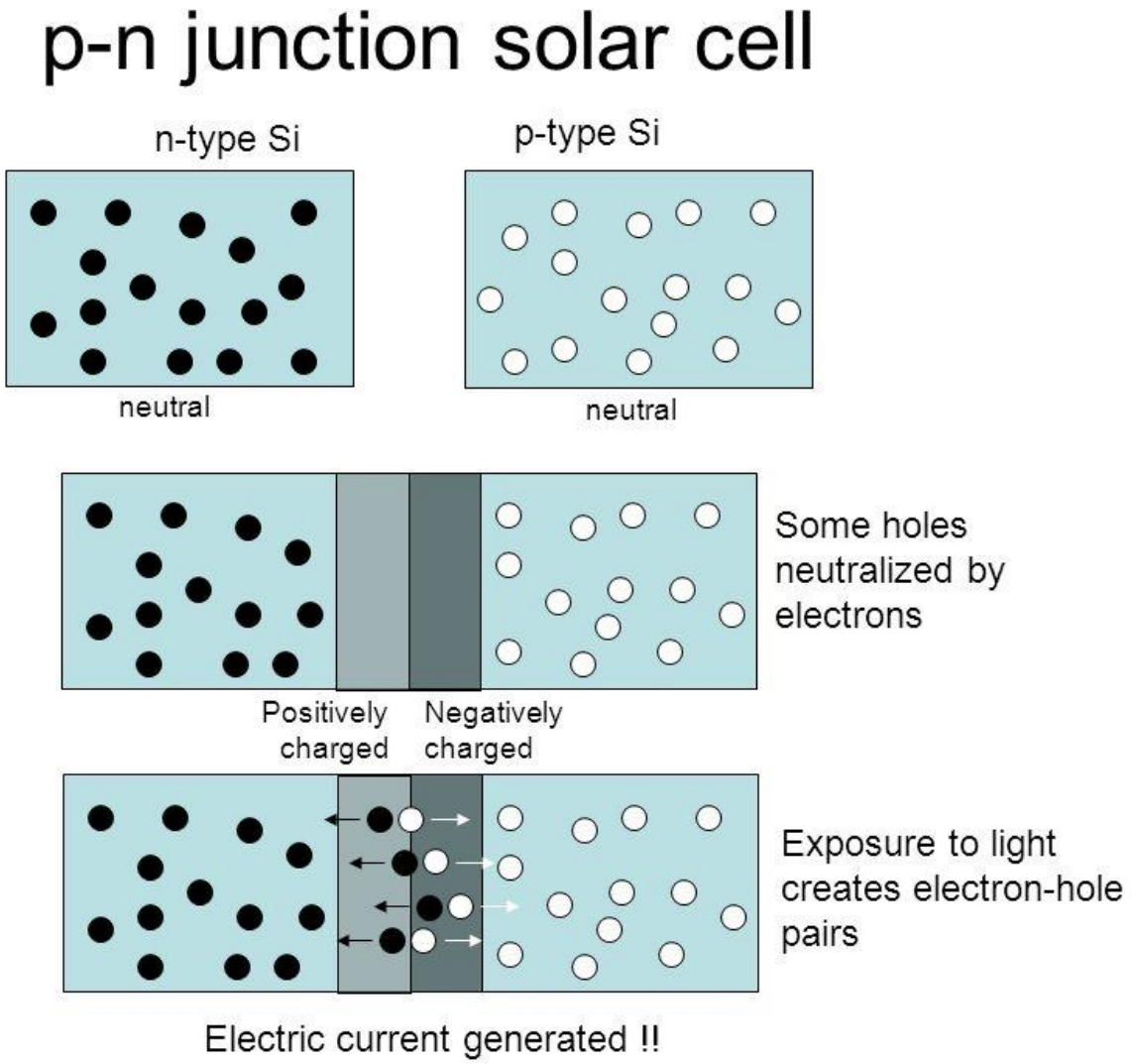




LED branco comum

LED branco de largo espectro

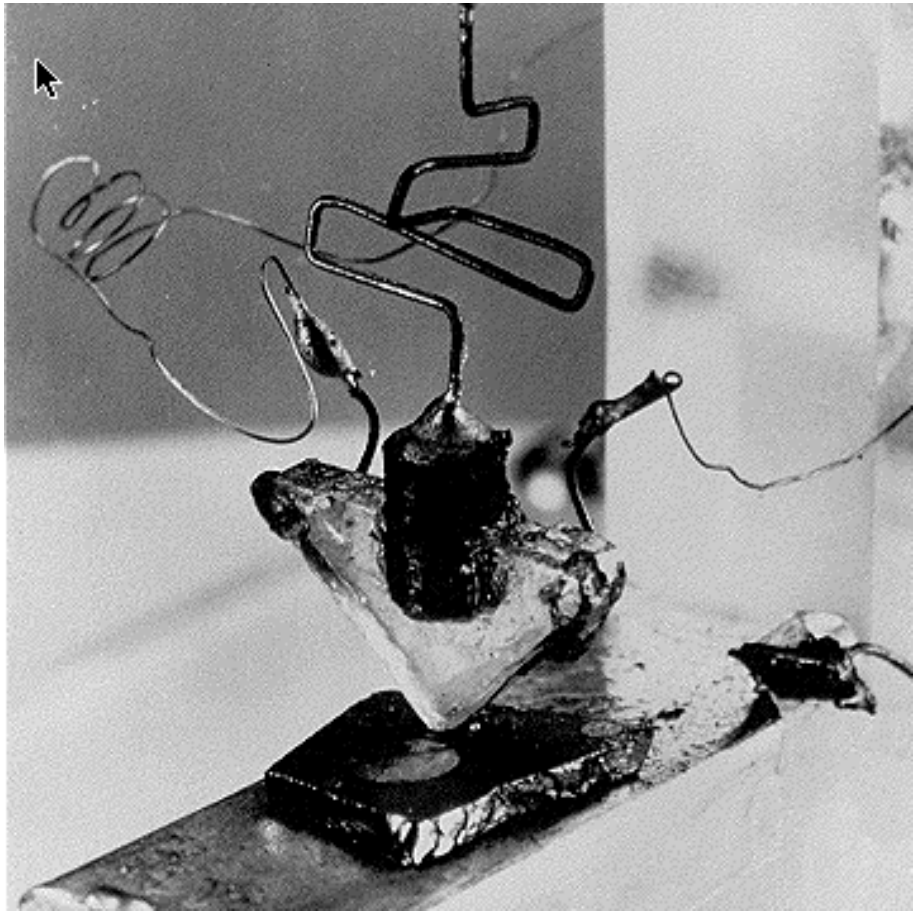
Célula fotovoltaica



Transistores bipolares

Um pouco de história
Princípio de funcionamento
Tipos: NPN e PNP

Transistor Ponto de Contato



Os inventores do transistor: Bardeen, Shockley e Brattain

Patente do transistor de ponto de contato (Bardeen & Brattain)

Oct. 3, 1950 J. BARDEEN ET AL 2,524,035

THREE-ELECTRODE CIRCUIT ELEMENT UTILIZING SEMICONDUCTIVE MATERIALS

Filed June 17, 1948 3 Sheets-Sheet 1

FIG. 1

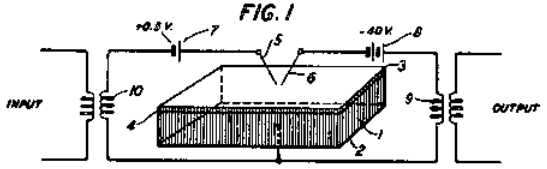


FIG. 1A

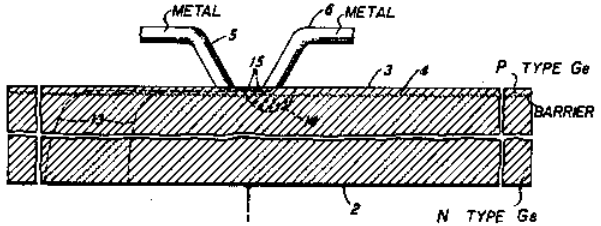


FIG. 2

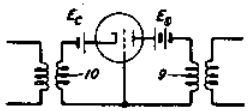


FIG. 10

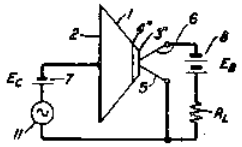


FIG. 11

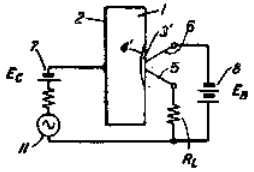
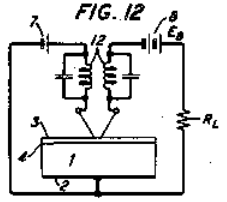
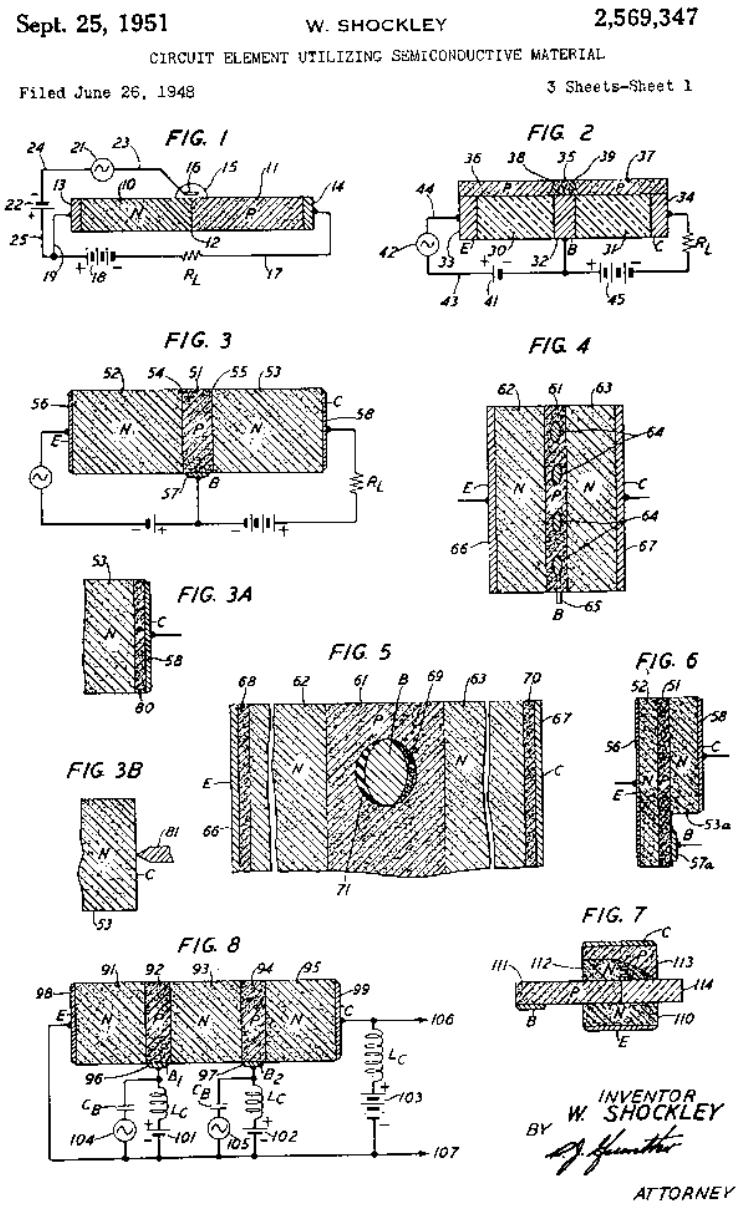


FIG. 12



INVENTORS: J. BARDEEN
W. H. BRATTAIN
BY Harry C. Hart
ATTORNEY

Patente do transistor sanduíche (Shockley)



Sept. 25, 1951 W. SHOCKLEY 2,569,347

CIRCUIT ELEMENT UTILIZING SEMICONDUCTIVE MATERIAL

Filed June 26, 1948 3 Sheets-Sheet 1

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 3A

FIG. 5

FIG. 6

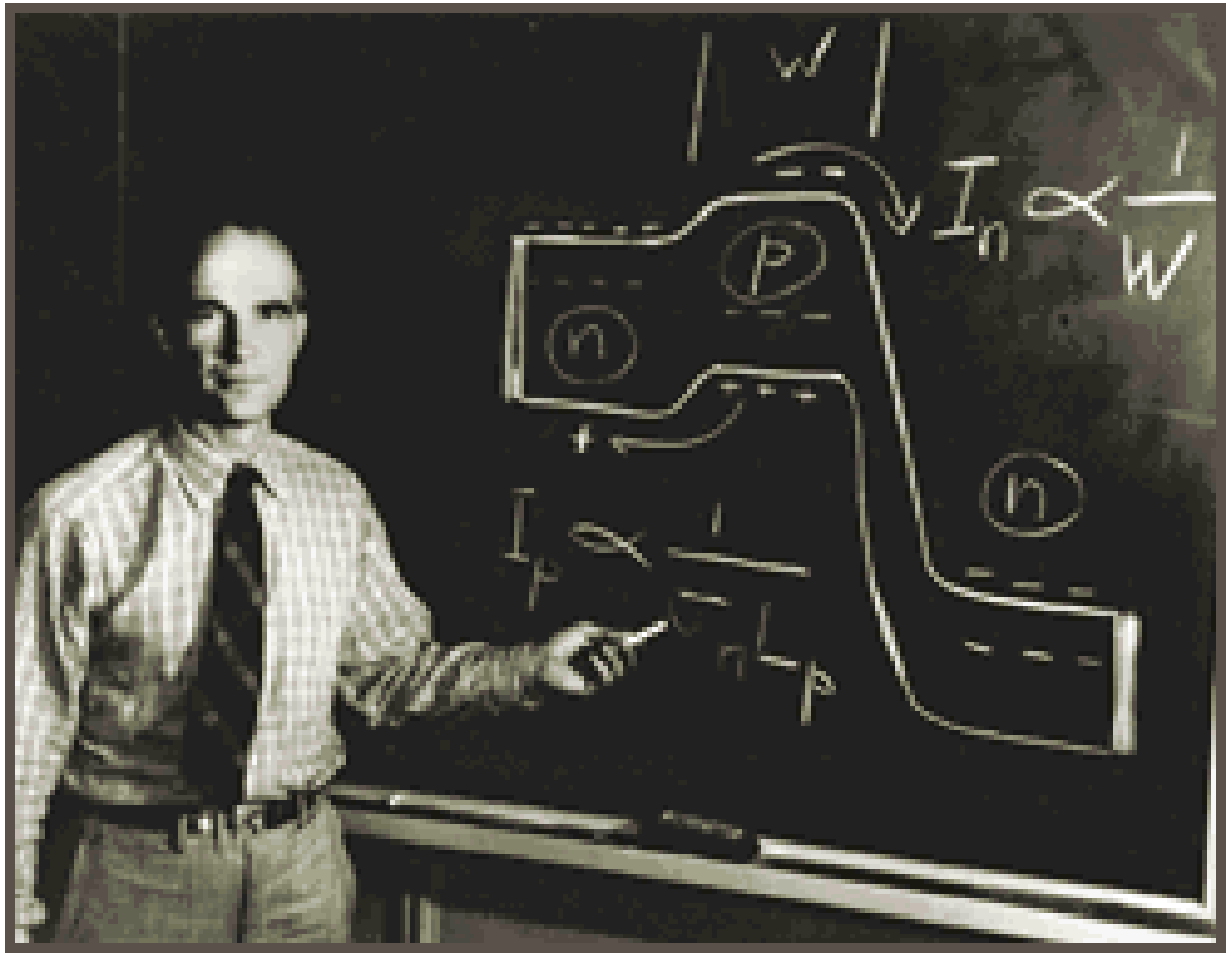
FIG. 3B

FIG. 8

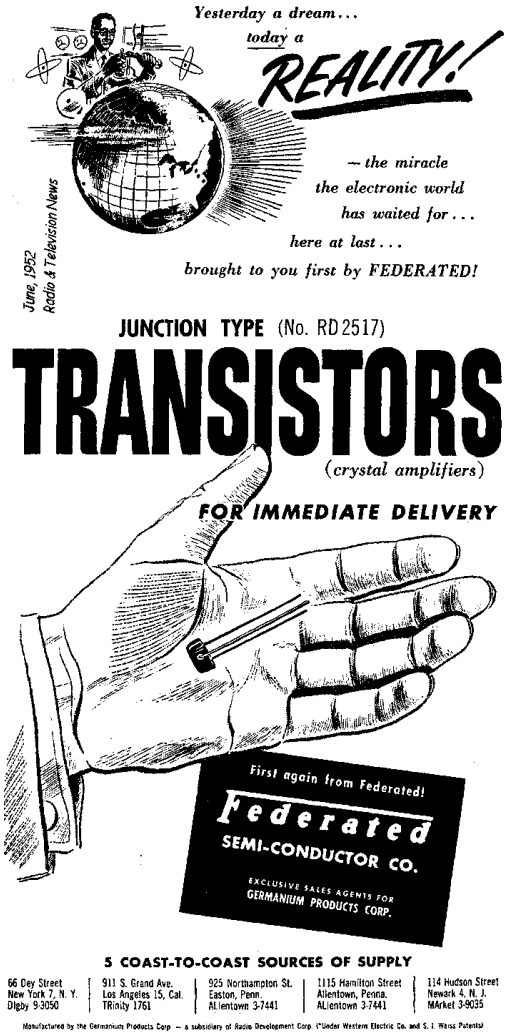
FIG. 7

INVENTOR
W. SHOCKLEY
BY
ATTORNEY

O “pai” do Vale do Silício: William Shockley



Propaganda


Yesterday a dream...
today a
REALITY!
— the miracle
the electronic world
has waited for...
here at last...
brought to you first by FEDERATED!
June, 1952
Radio & Television News
JUNCTION TYPE (No. RD2517)
TRANSISTORS
(crystal amplifiers)
FOR IMMEDIATE DELIVERY
First again from Federated!
Federated
SEMI-CONDUCTOR CO.
EXCLUSIVE SALES AGENTS FOR
GERMANIUM PRODUCTS CORP.
5 COAST-TO-COAST SOURCES OF SUPPLY
66 Dey Street
New York 7, N. Y.
Digby 9-3050
911 S. Grand Ave.
Los Angeles 15, Cal.
TRinity 1761
925 Northampton St.
Easton, Penn.
ALlentown 5-7441
1115 Hamilton Street
Allentown, Penna.
ALlentown 3-7441
114 Hudson Street
Newark 4, N. J.
MArket 3-9035
Manufactured by the Germanium Products Corp. — a subsidiary of Radio Development Corp. (*Under Western Electric Co. and S. I. Weiss Patents)

Propaganda


TAKE THIS
ACTUAL SAMPLE
OF AN ELECTRONIC
Miracle!
A RAYTHEON
TRANSISTOR
This is a mechanical sample only - an electrical "reject". It will not work.
RAYTHEON
Raytheon . . . Electronic Miracle Maker for Over a Quarter of a Century . . . Presents You with This Sample of a Transistor.
Here's WHY it's wonderful:
• Never wears out.
• Can't burn out.
• Won't deteriorate.
• Impervious to moisture.
• Resistant to jars and jolts.
• Uses almost no current.
• Gives greater undistorted volume.
Here's what it means to YOU . . .

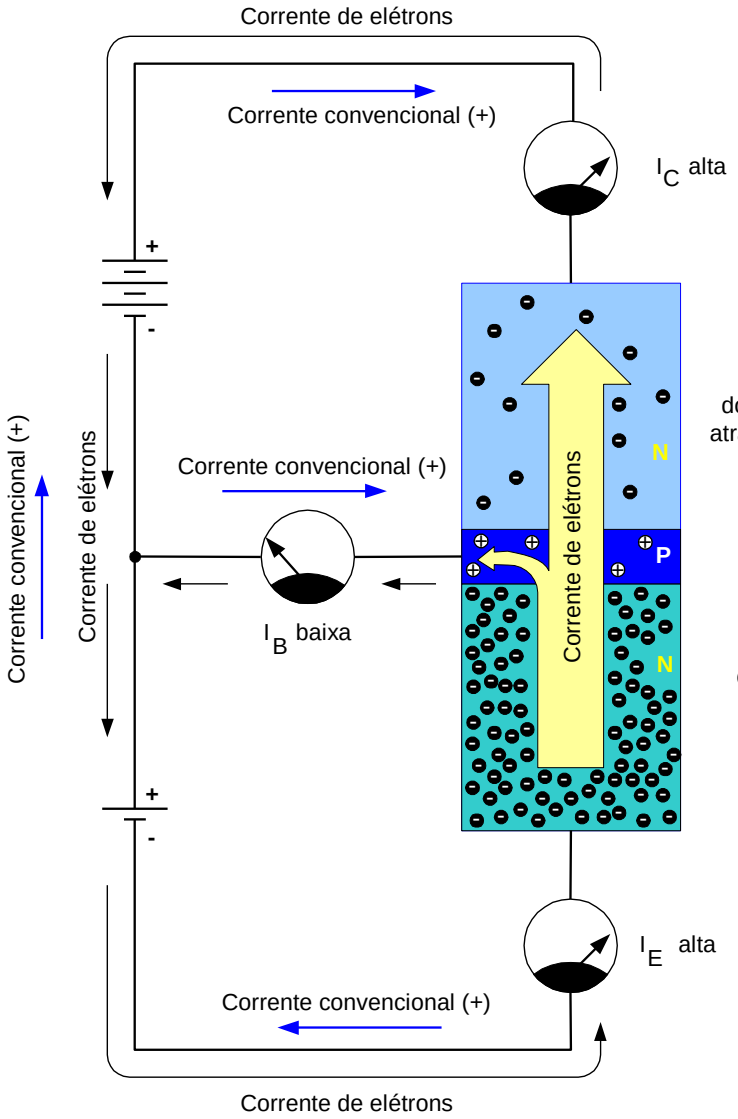

Miracle Radio!
NO TUBES!
Nothing to Plug in!
Over 500 Hours on Flashlight Batteries!
Speaker Grilles Front and Back for 360° of Rich "Live" Sound!
Tiny transistors replace bulky radio tubes — withstand hard knocks — use almost no current. Far more convenient and actually costs less to operate than conventional AC-DC radio sets. Genuine leather case. Luggage brass control knobs. Long shoulder strap or short carrying handle.
RAYTHEON
Transistor
RADIO
world's largest producers of transistors
Form No. 1025 — 20M-P
Litho. in U.S.A. — 9-55

Transistor bipolar

Princípio de funcionamento:

Os portadores majoritários bem como os portadores minoritários participam do processo de condução elétrica, daí o nome transistor bipolar.

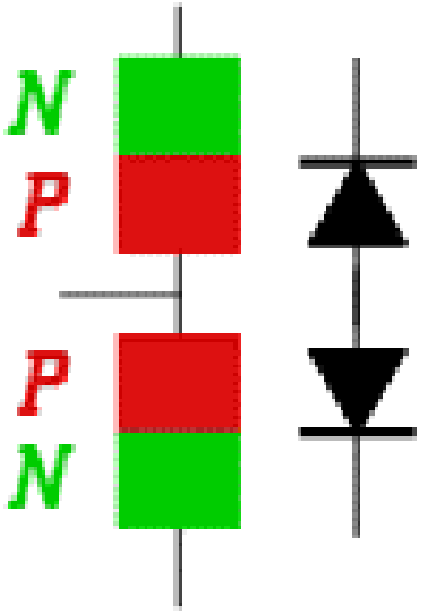
Transistor bipolar NPN



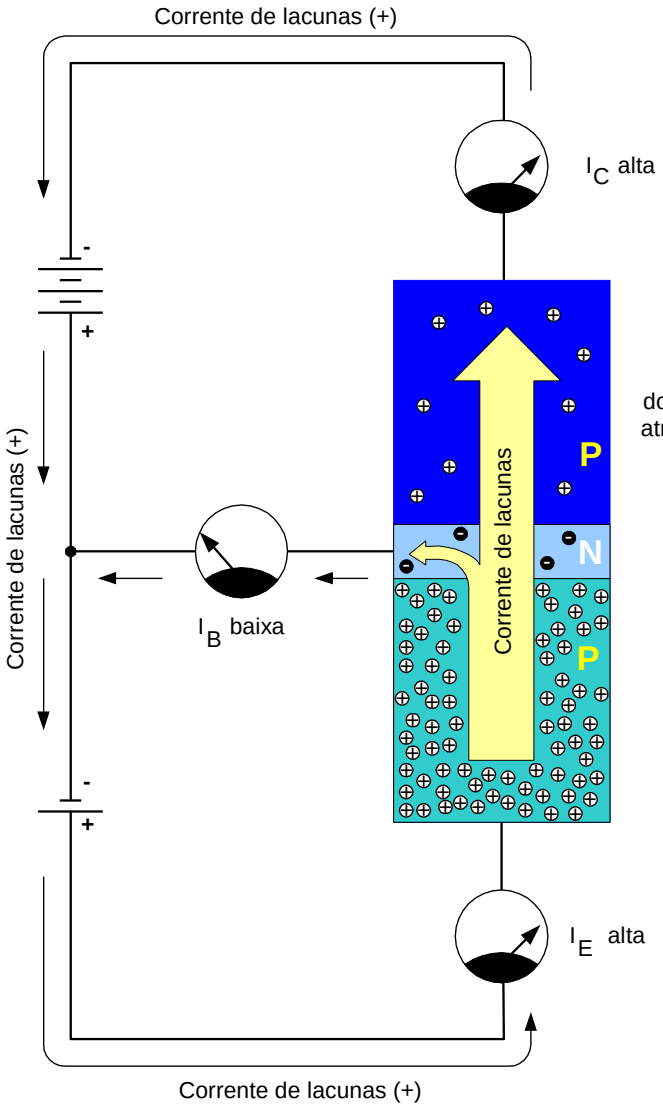
O coletor, levemente dopado, está "positivo"e atrai os elétrons vindos do emissor

A base está pobre de lacunas

O emissor, altamente dopado, está "rico" de elétrons



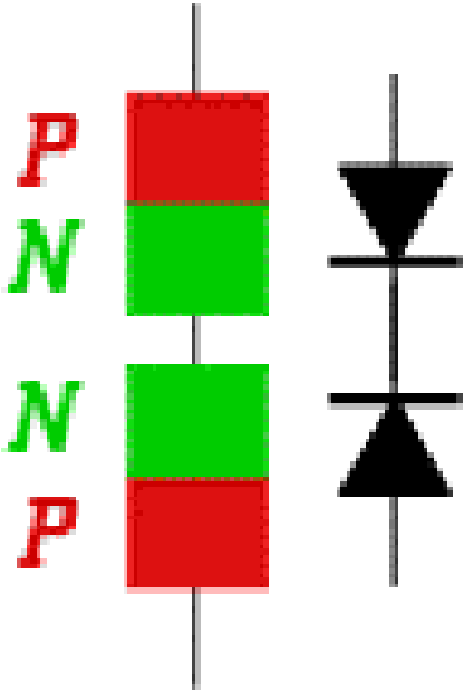
Transistor bipolar PNP



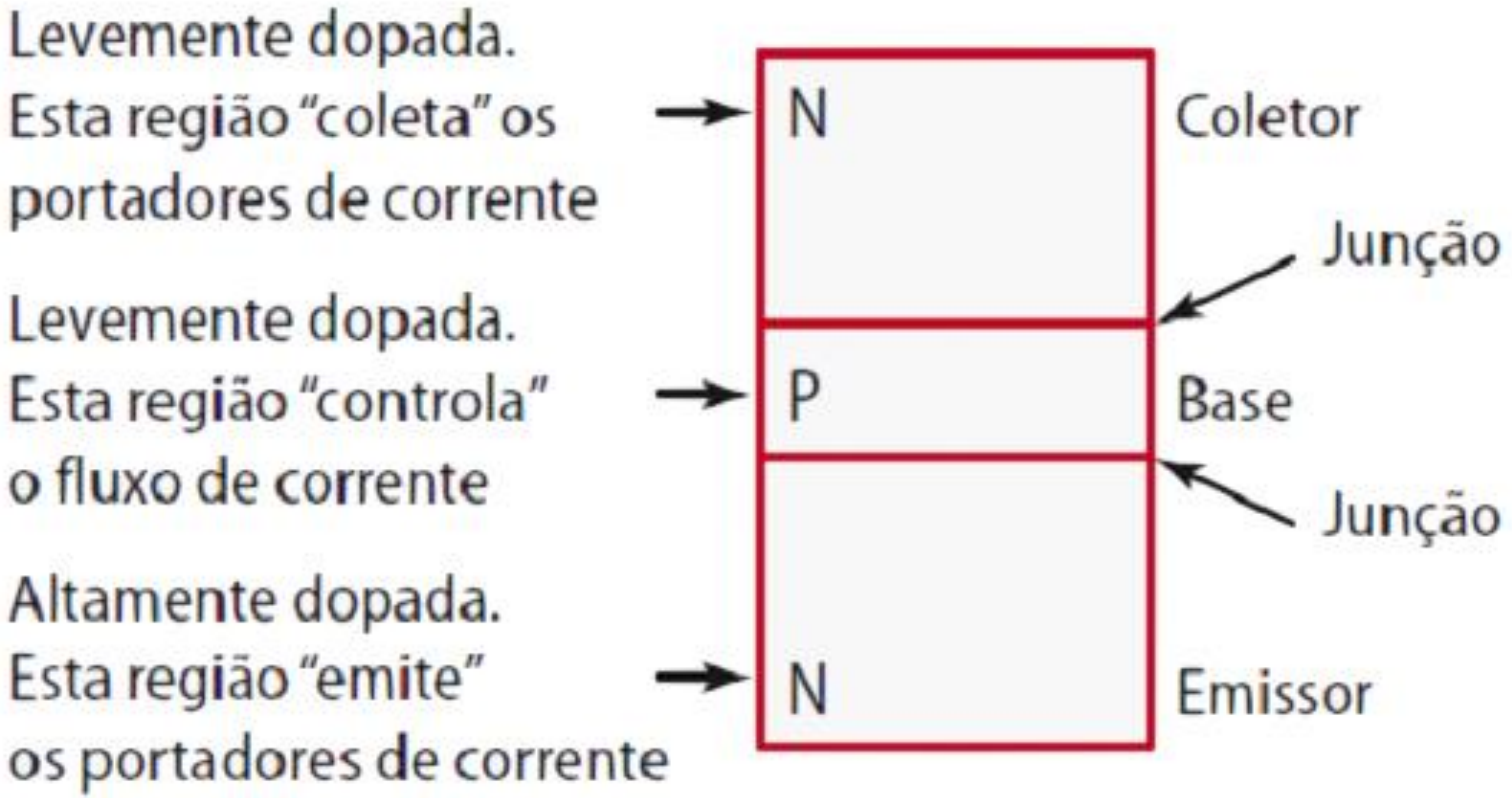
O coletor, levemente dopado, está "negativo" e atrai as lacunas vindas do emissor

A base está pobre de elétrons

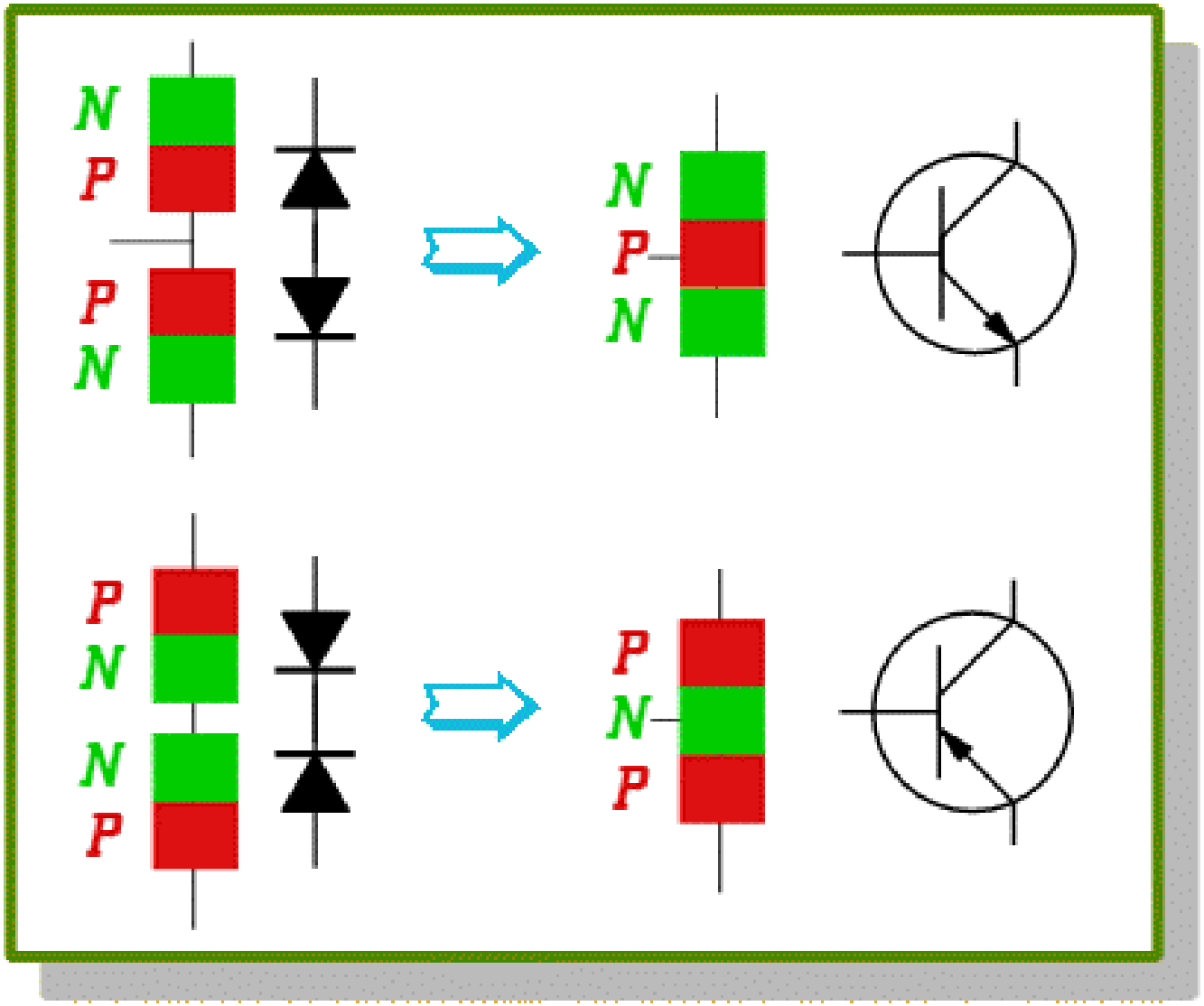
O emissor, altamente dopado, está "rico" de lacunas



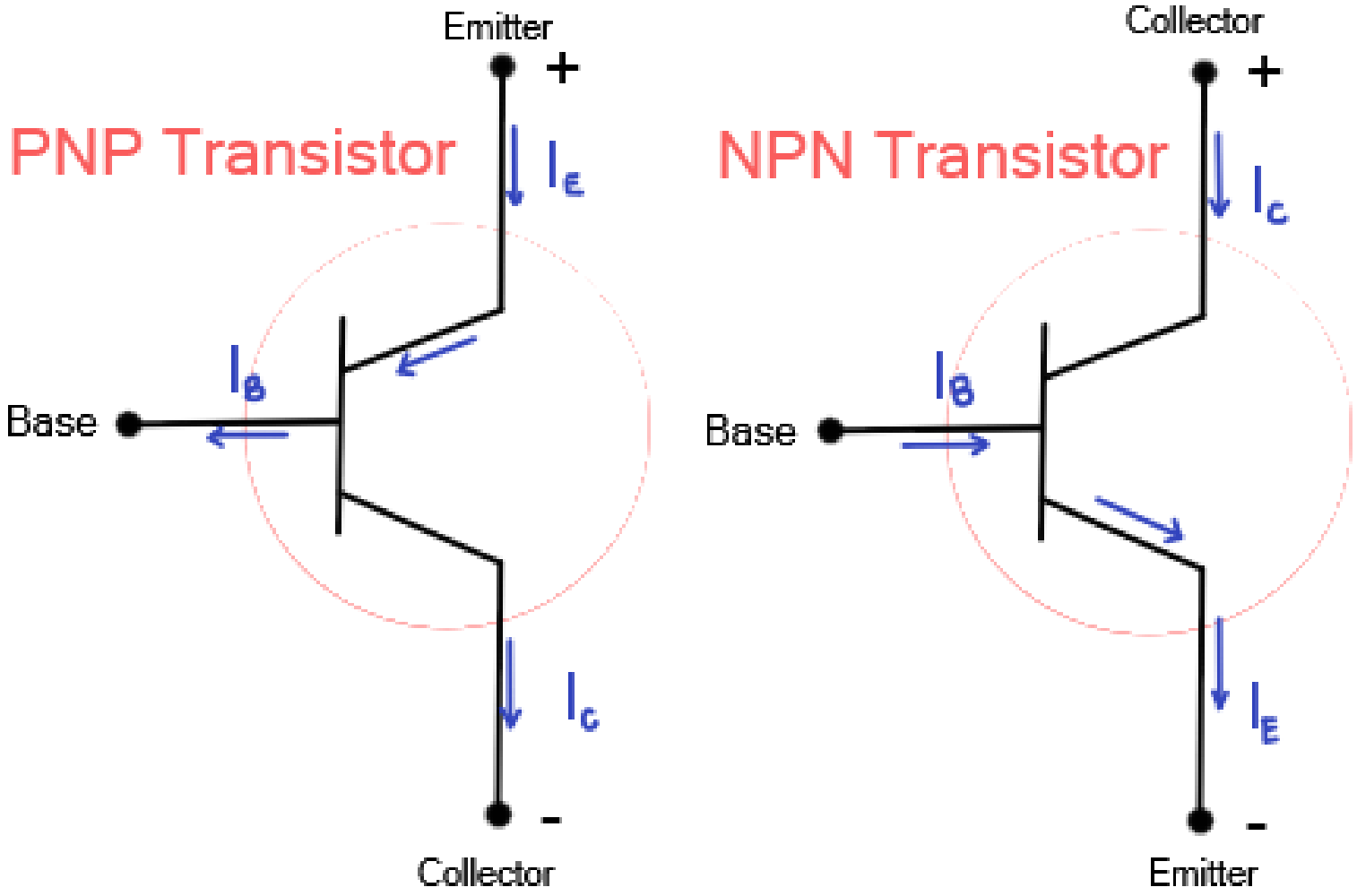
Estrutura de um transistor bipolar NPN



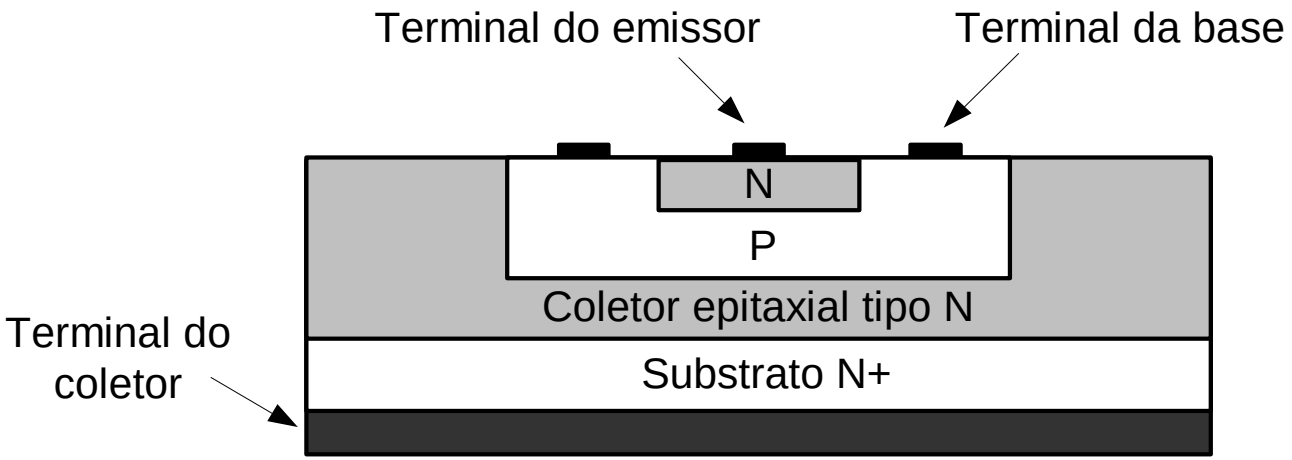
Transistores bipolar NPN e PNP

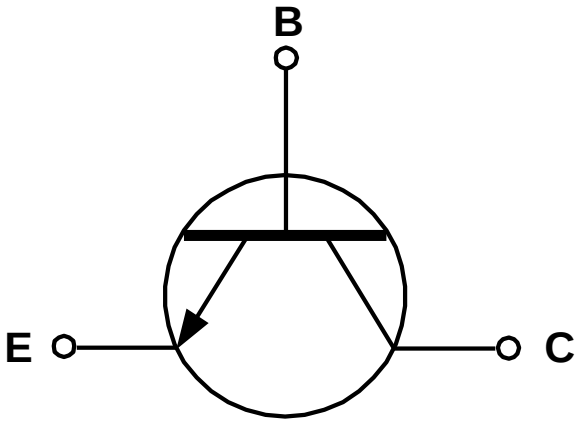


Transistores bipolar NPN e PNP

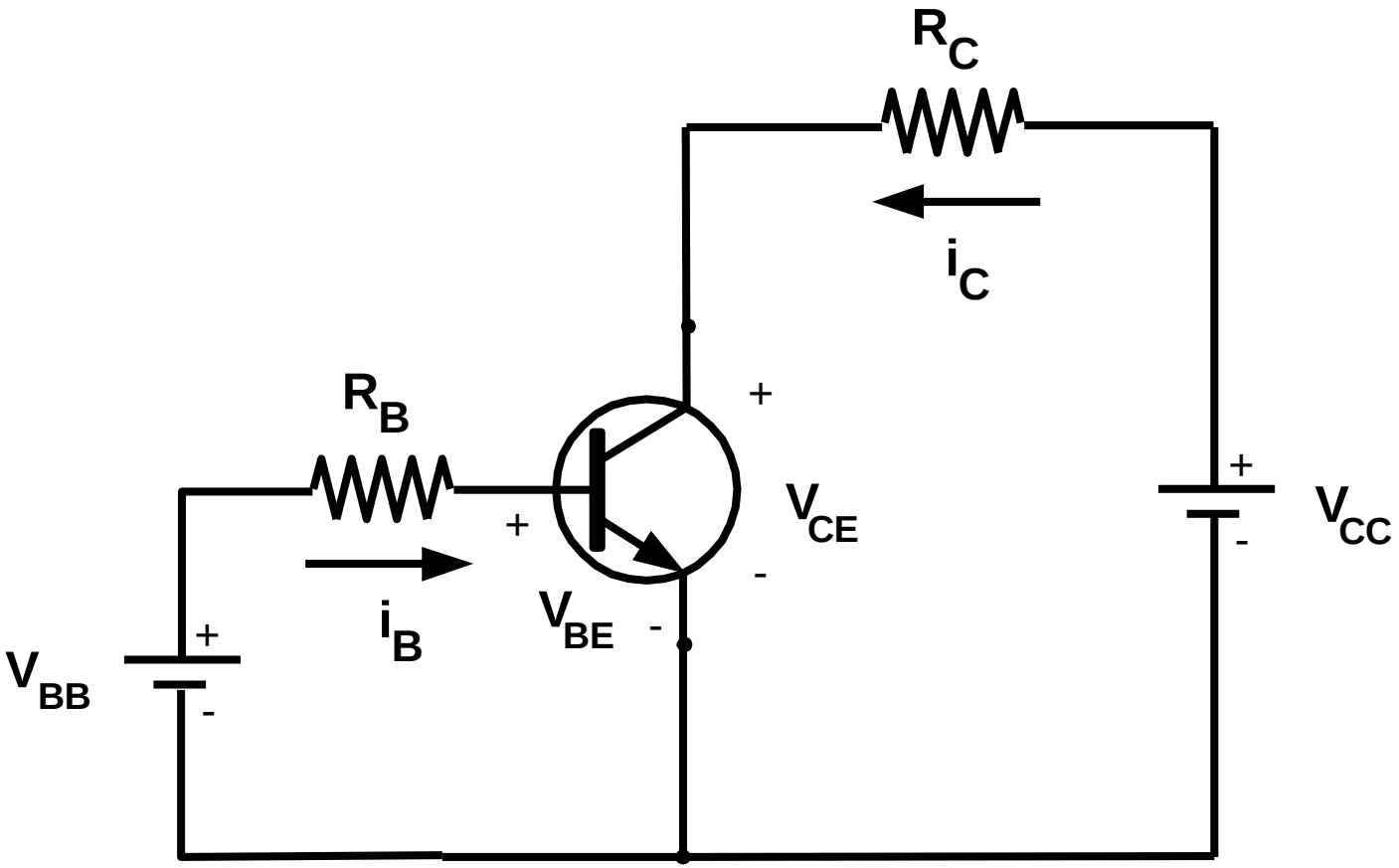


Transistor NPN epitaxial planar

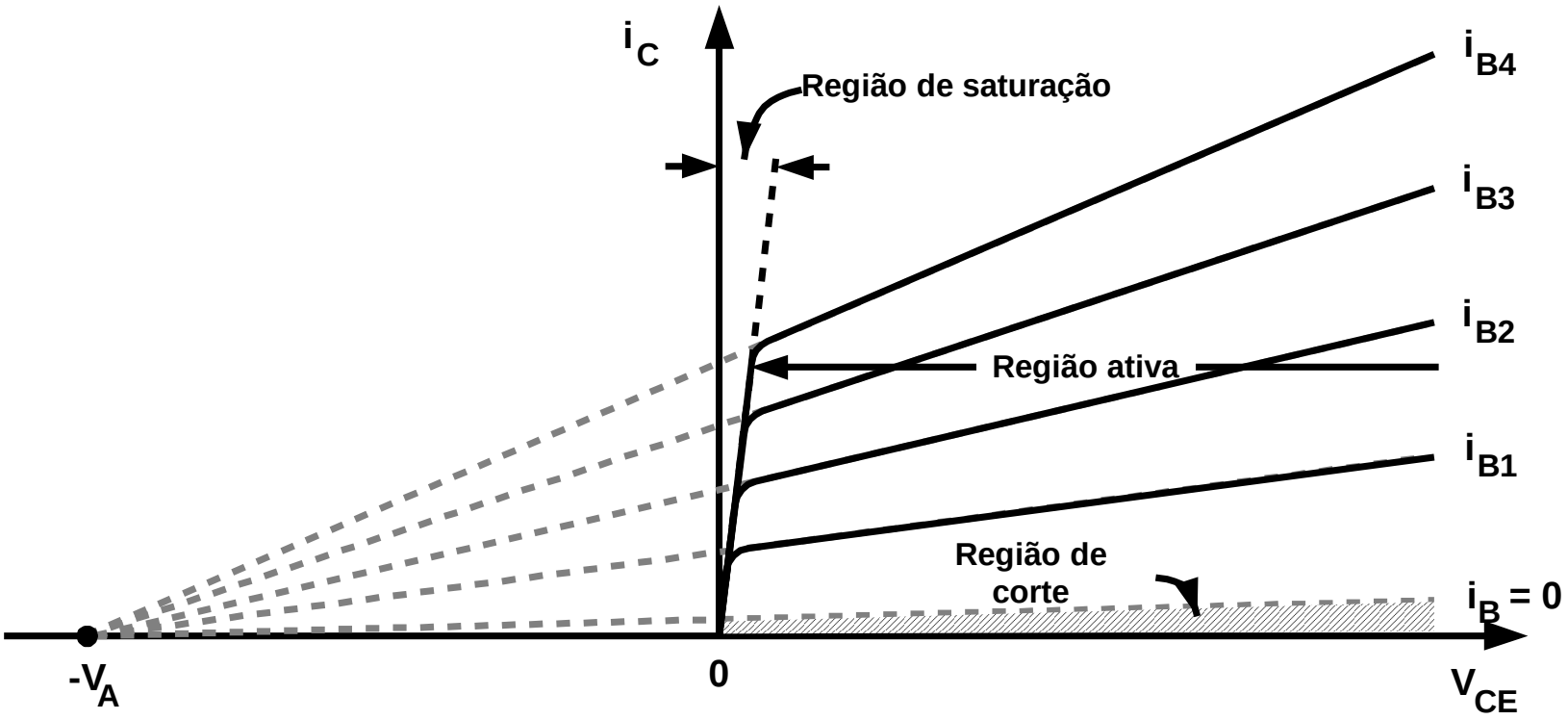




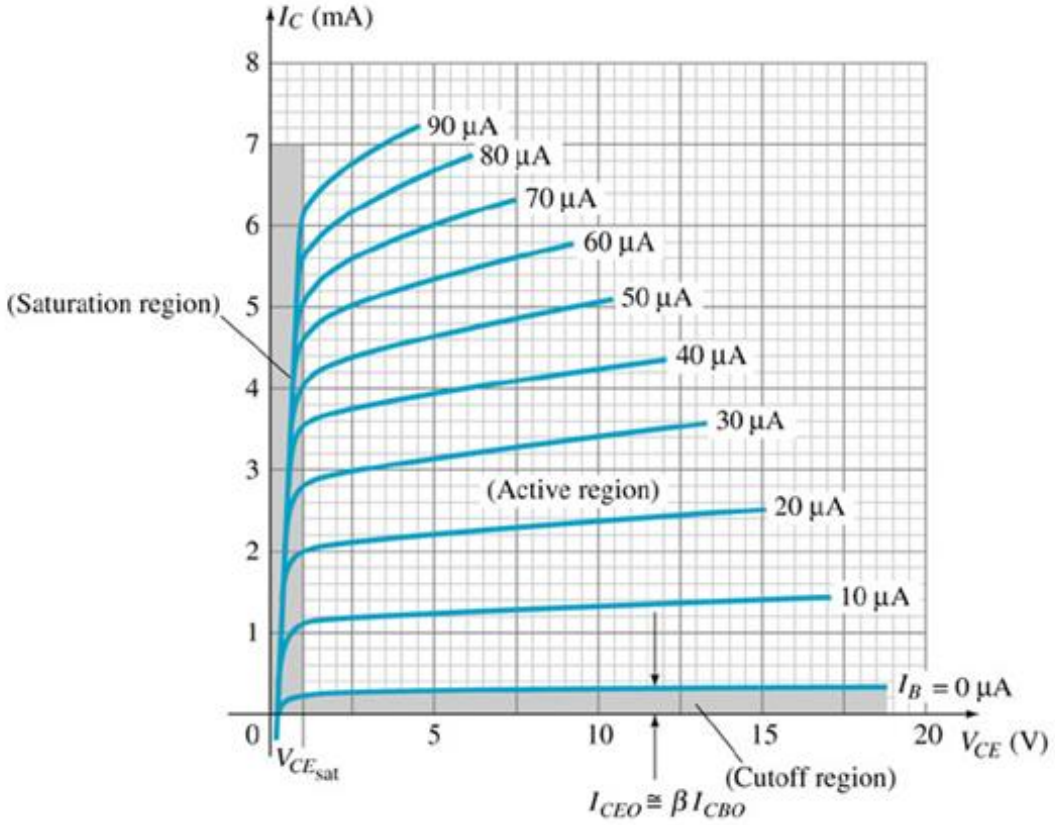
Circuito de polarização do transistor bipolar



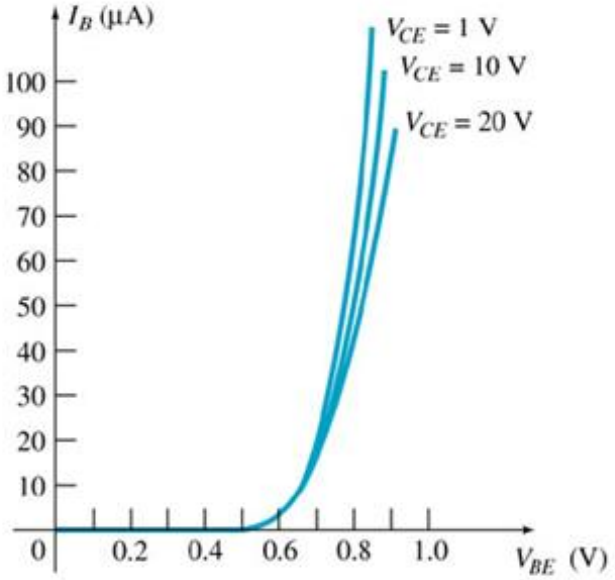
Curva I_c-V_{CE} do transistor bipolar



Curvas características I-V do transistor bipolar NPN: configuração emissor comum



(a)



(b)

Datasheet do transistor 2N4123

2N4123, 2N4124

General Purpose Transistors

NPN Silicon

ON Semiconductor®

http://onsemi.com

Features

- Pb−Free Packages are Available*

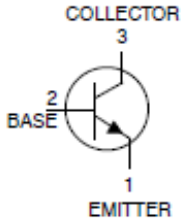
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−Emitter Voltage 2N4123 2N4124	V_{CEO}	 30 25	Vdc
Collector−Base Voltage 2N4123 2N4124	V_{CBO}	 40 30	Vdc
Emitter−Base Voltage	V_{EBO}	5.0	Vdc
Collector Current − Continuous	I_C	200	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

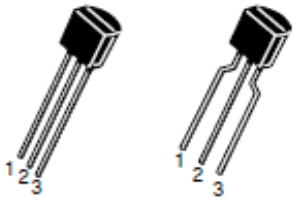
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	83.3	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



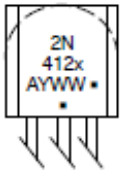
TO−92
CASE 29
STYLE 1



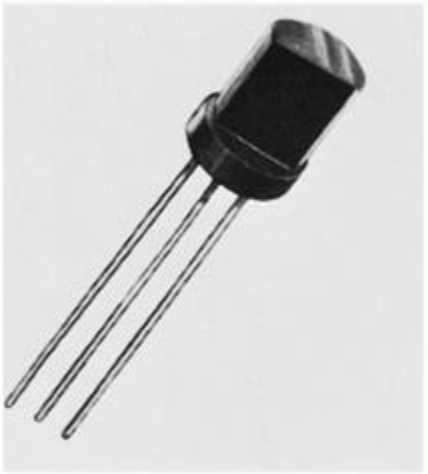
STRAIGHT LEAD
BULK PACK

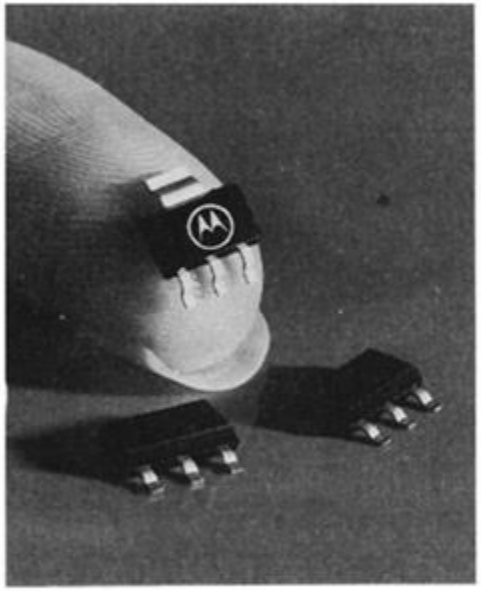
BENT LEAD
TAPE & REEL
AMMO PACK

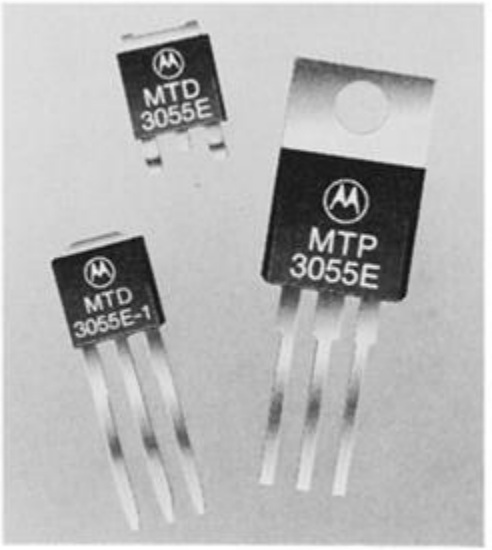
MARKING DIAGRAM



Tipos de encapsulamento de transistores



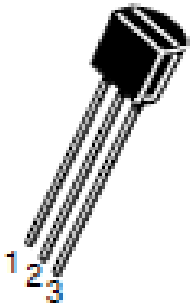




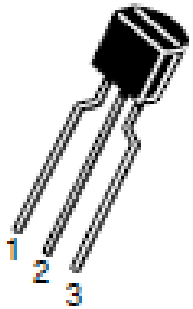
(c)

(d)

TO–92
CASE 29
STYLE 1

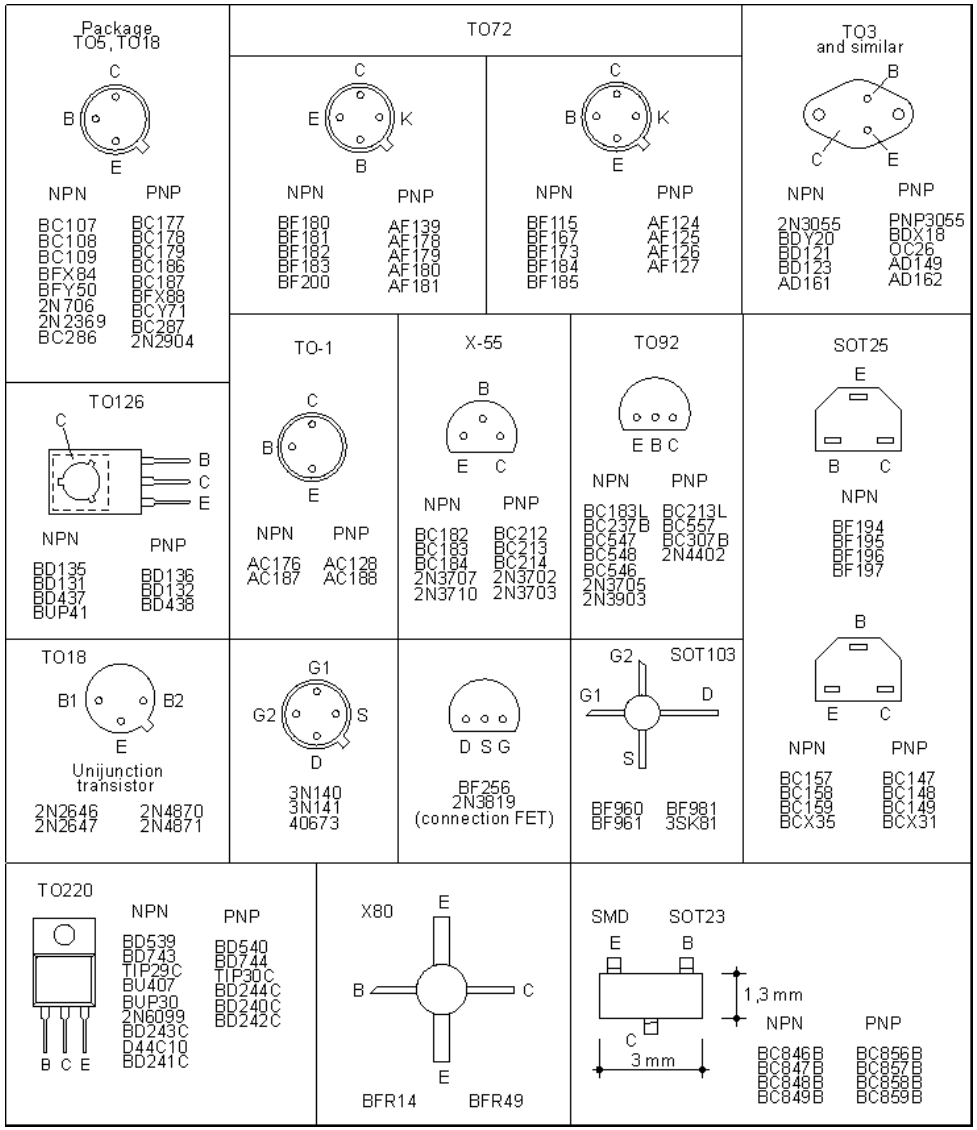


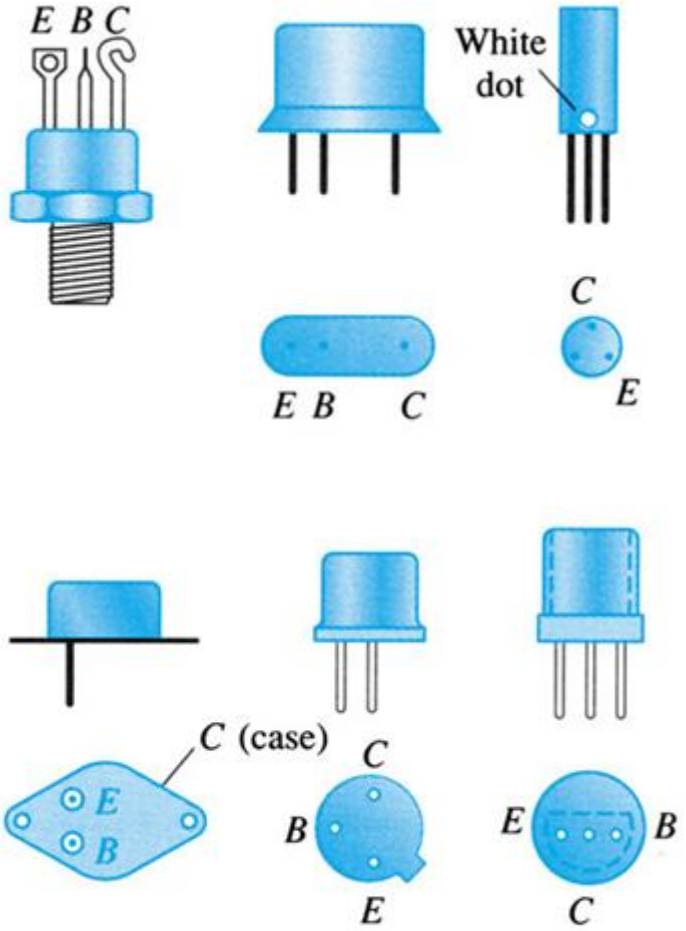
STRAIGHT LEAD
BULK PACK



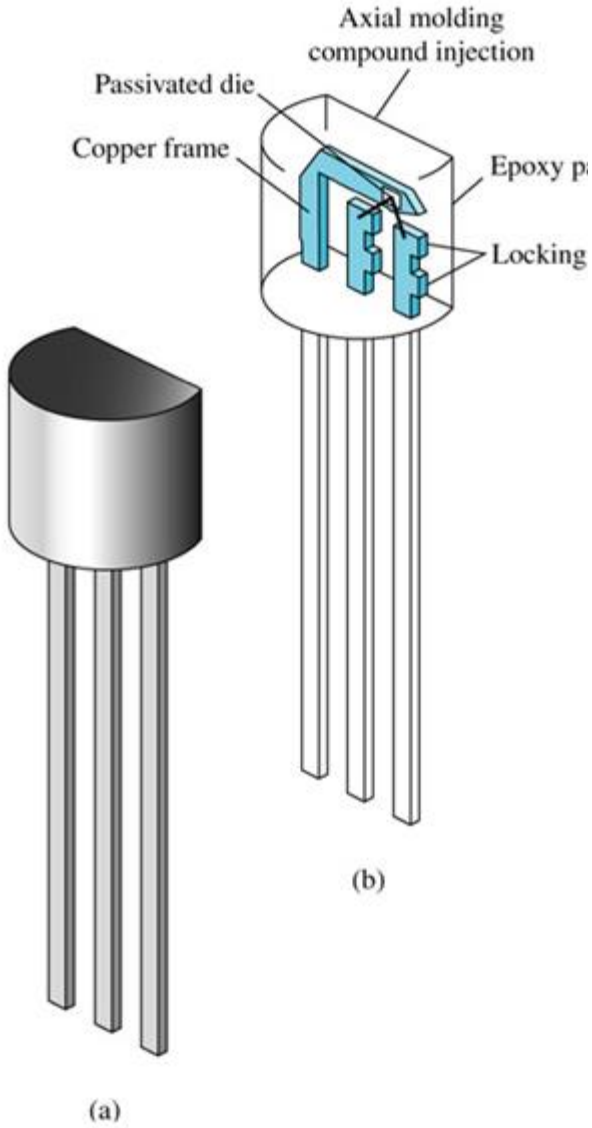
BENT LEAD
TAPE & REEL
AMMO PACK

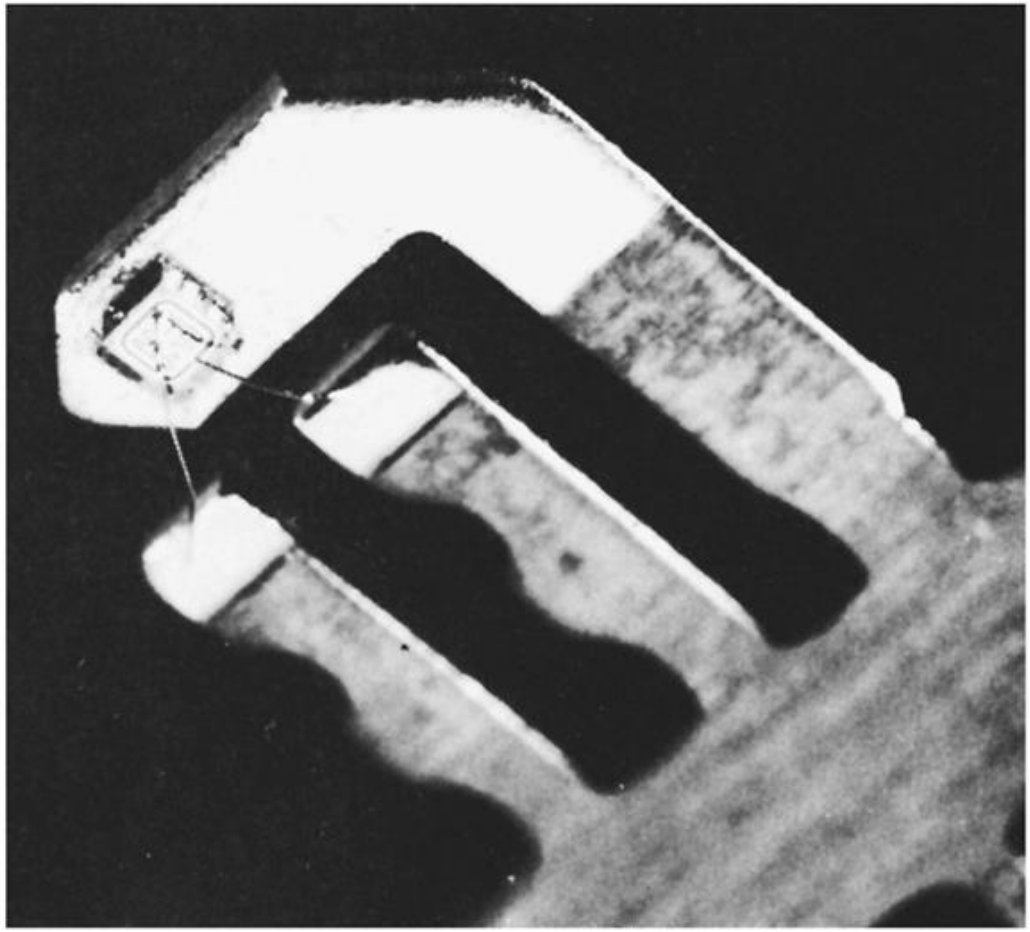
Identificação de terminais de transistores



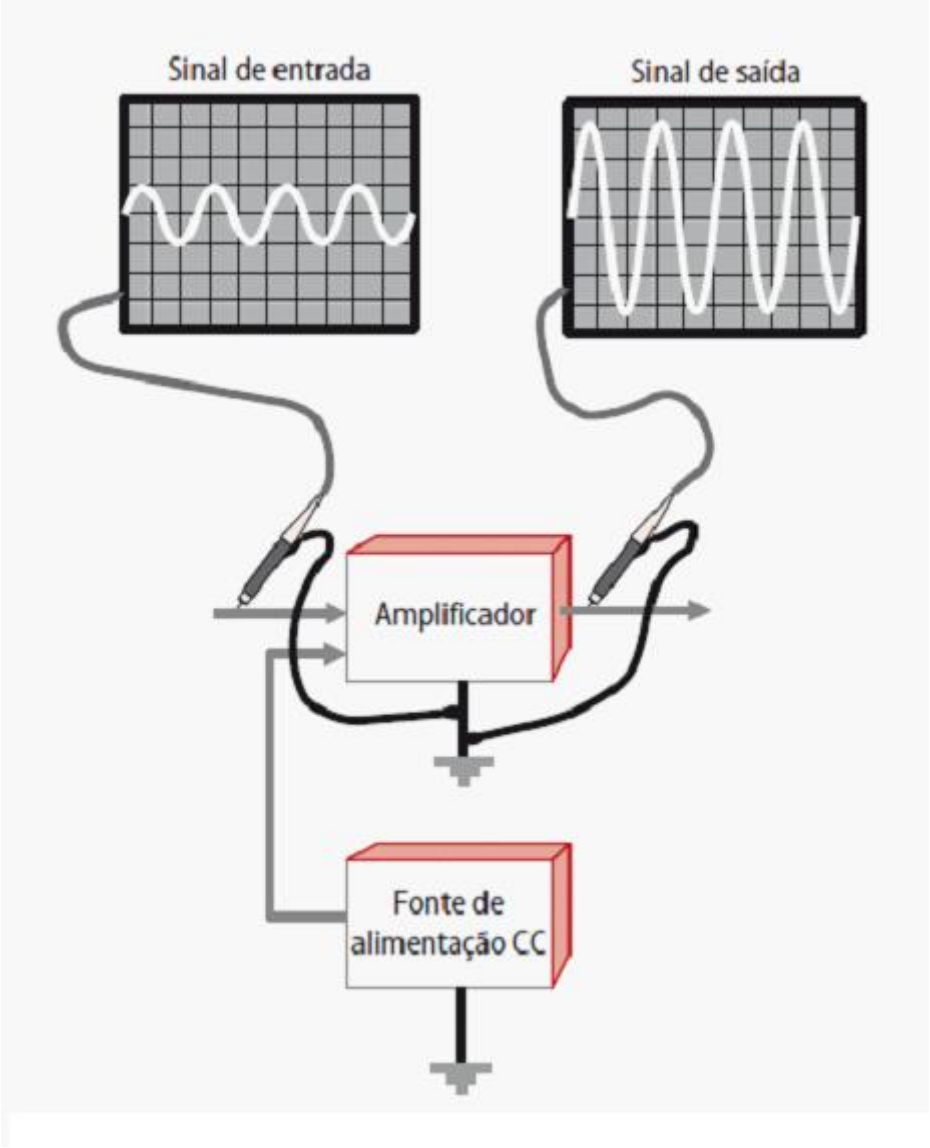


Construção interna de transistores





Esquema de um amplificador de sinal



Transistor bipolar como amplificador