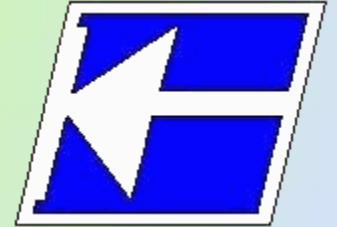


Centro Federal de Educação Tecnológica de Santa Catarina
Departamento Acadêmico de Eletrônica
Retificadores



Características dos diodos

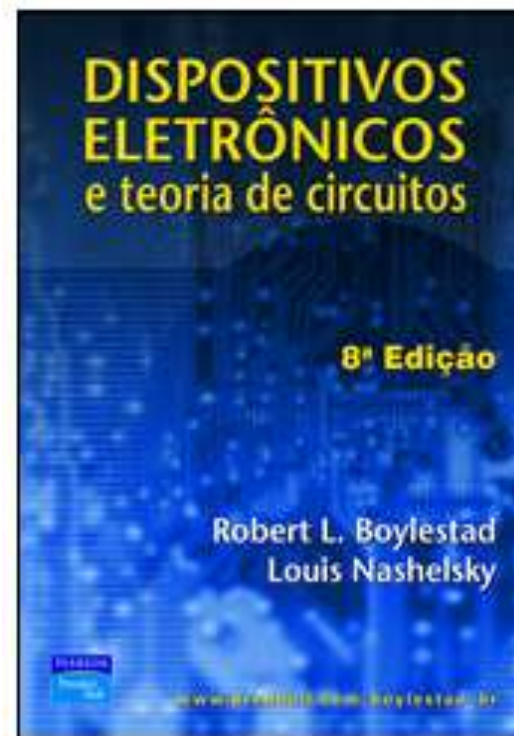
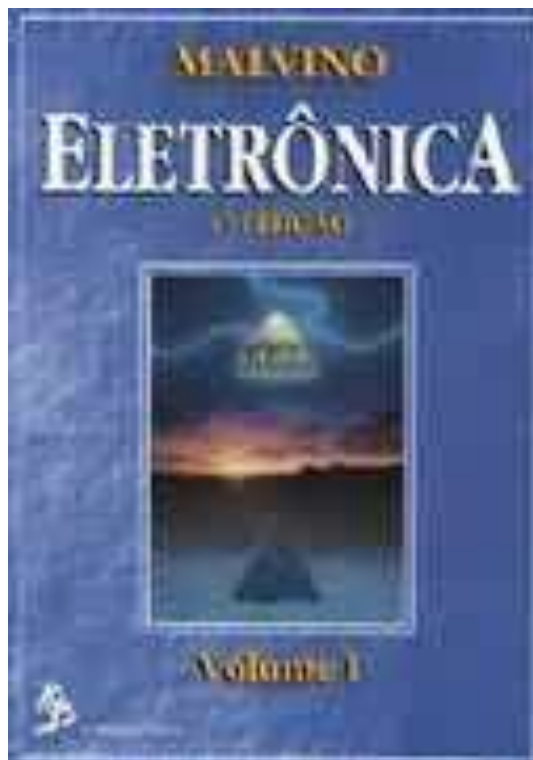
Prof. Clóvis Antônio Petry.

Florianópolis, outubro de 2008.

Bibliografia para esta aula

Capítulo 1: Diodos semicondutores

1. Características dos diodos.



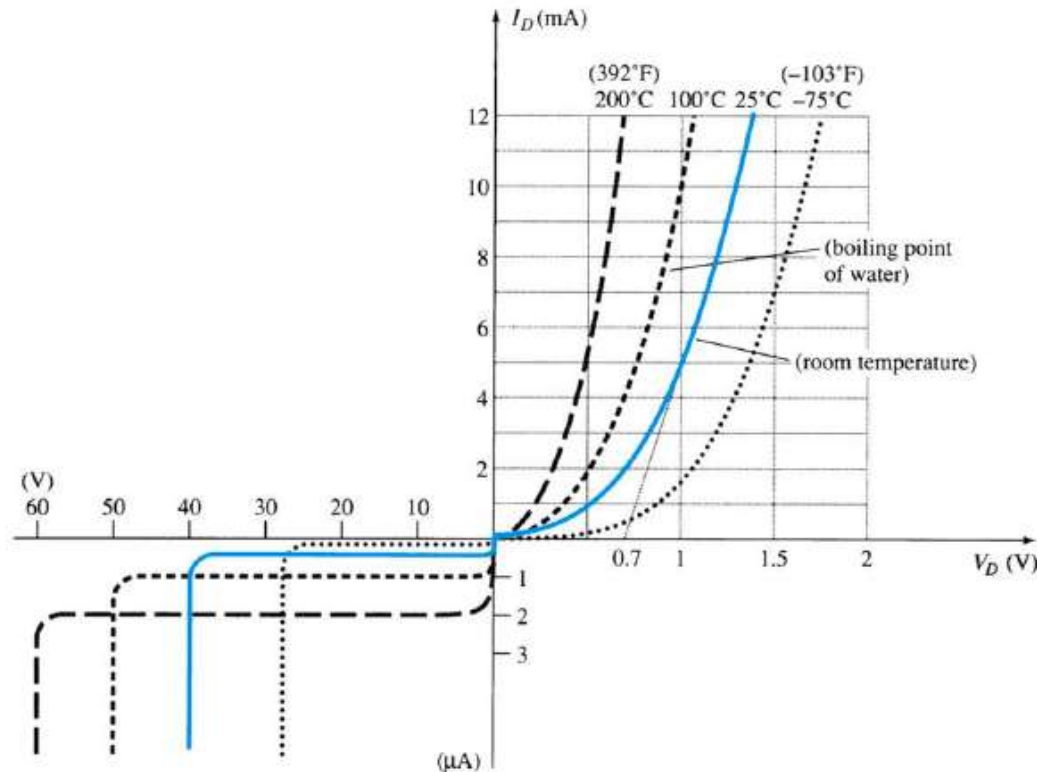
Nesta aula

Seqüência de conteúdos:

1. Efeito da temperatura;
2. Silício versus germânio;
3. Região zener;
4. Resistências do diodo;
5. Modelo ideal do diodo;
6. Modelo simplificado do diodo;
7. Modelo linear por partes do diodo;
8. Características dos diodos;
9. Testes de diodos com multímetros.

Efeito da temperatura na junção P-N

A corrente de saturação reversa I_S terá sua amplitude praticamente dobrada para aumento de 10°C na temperatura.



Efeito da temperatura na junção P-N

Exemplo 2.6 – Eletrônica, vol. 1:

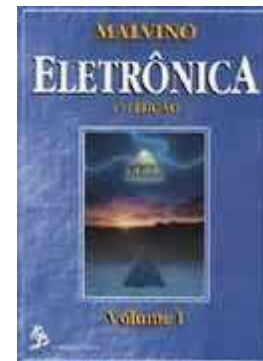
- Qual a barreira de potencial de um diodo de silício quando a temperatura na junção for de 100 °C.

Solução: Se a temperatura na junção aumentar para 100 °C, a barreira de potencial diminui para:

$$(100^{\circ}C - 25^{\circ}C) \cdot 2mV = 150mV = 0,15V$$

A barreira de potencial passa a ser:

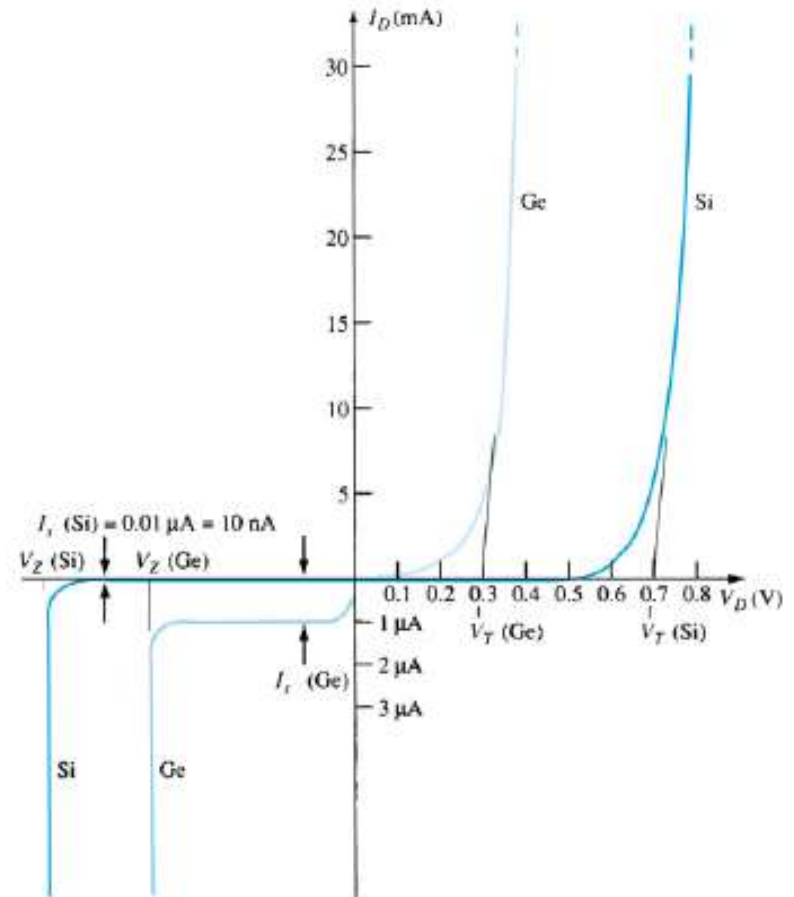
$$V_B = 0,7V - 0,15V = 0,55V$$



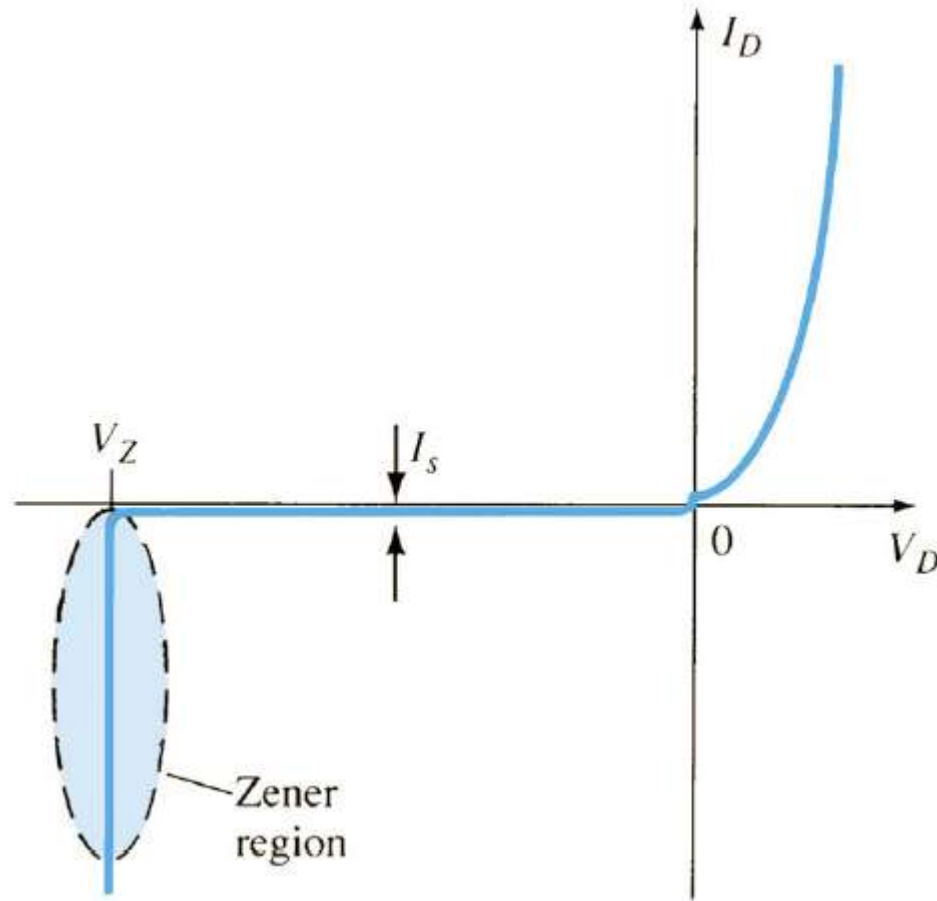
Exemplo 2.6 do Malvino.

Silício versus germânio

- Tensão reversa:
 - Silício: 1000 V;
 - Germânio: 400 V.
- Temperatura de operação:
 - Silício: 200 °C;
 - Germânio: 100 °C.
- Queda de tensão direta:
 - Silício: 0,7 V;
 - Germânio: 0,3 V.



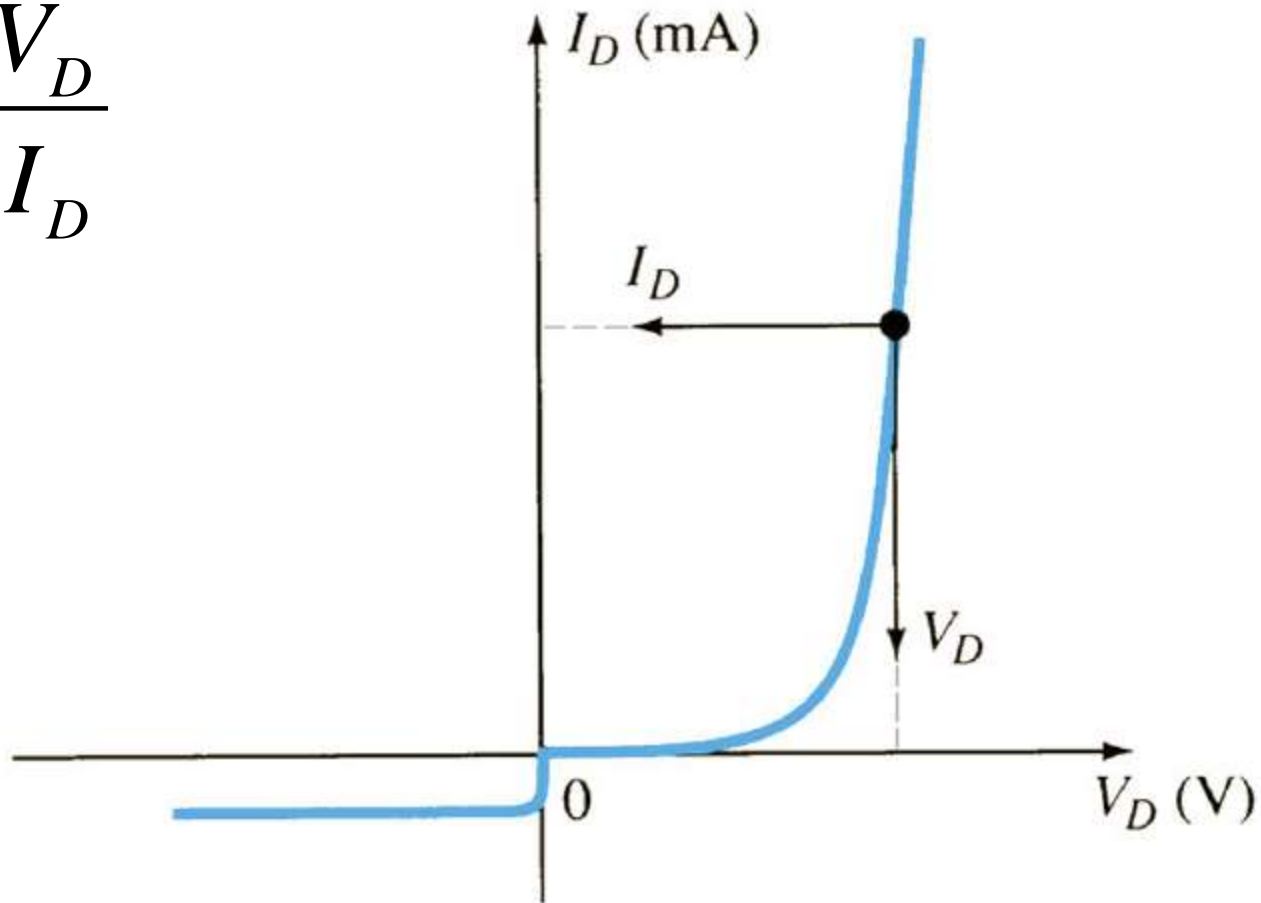
Diodo – Região zener



Resistências do diodo

Resistência CC ou estática:

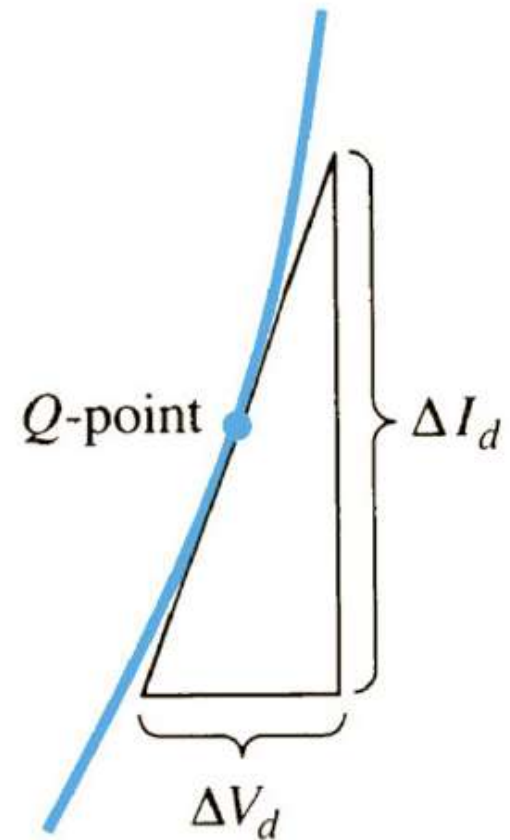
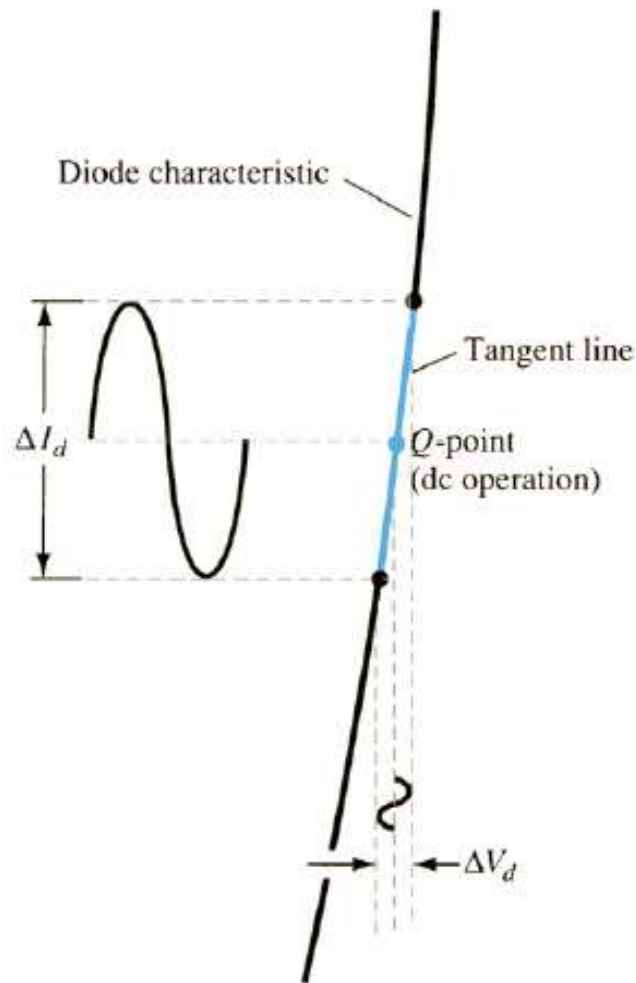
$$R_D = \frac{V_D}{I_D}$$



Resistências do diodo

Resistência CA ou dinâmica:

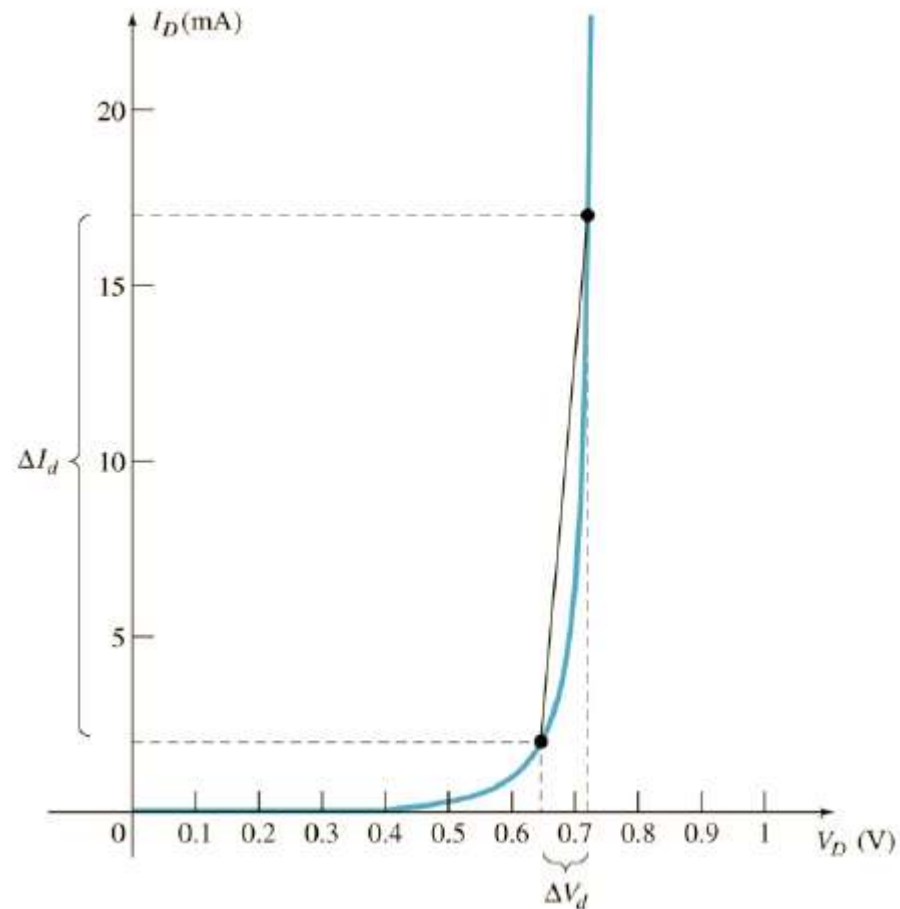
$$r_D = \frac{\Delta V_D}{\Delta I_D}$$



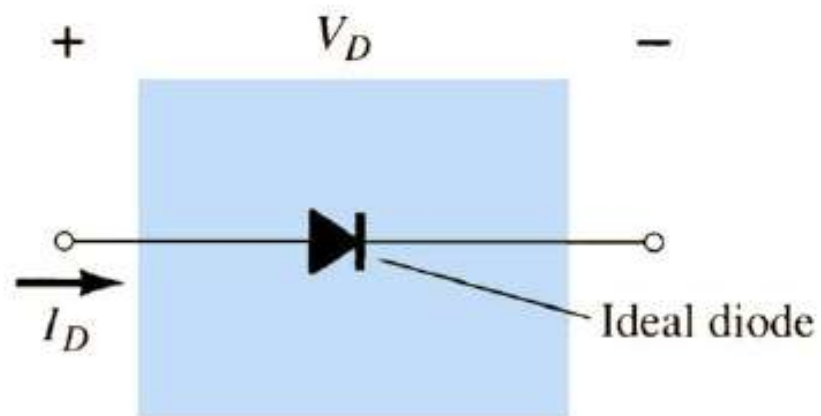
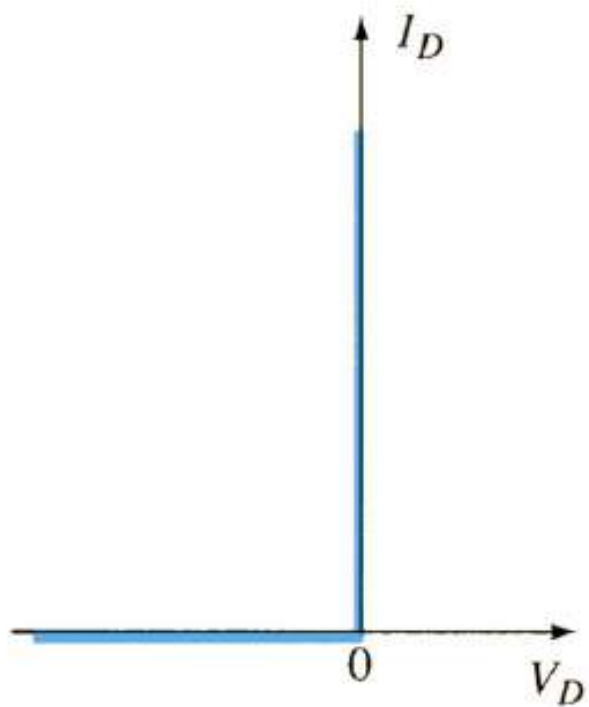
Resistências do diodo

Resistência CA média ou resistência de corpo:

$$r_{av} = \frac{\Delta V_d}{\Delta I_d}$$



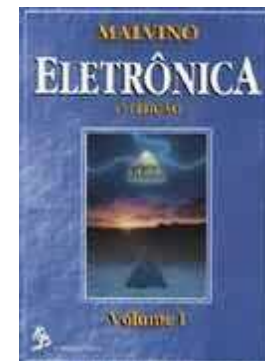
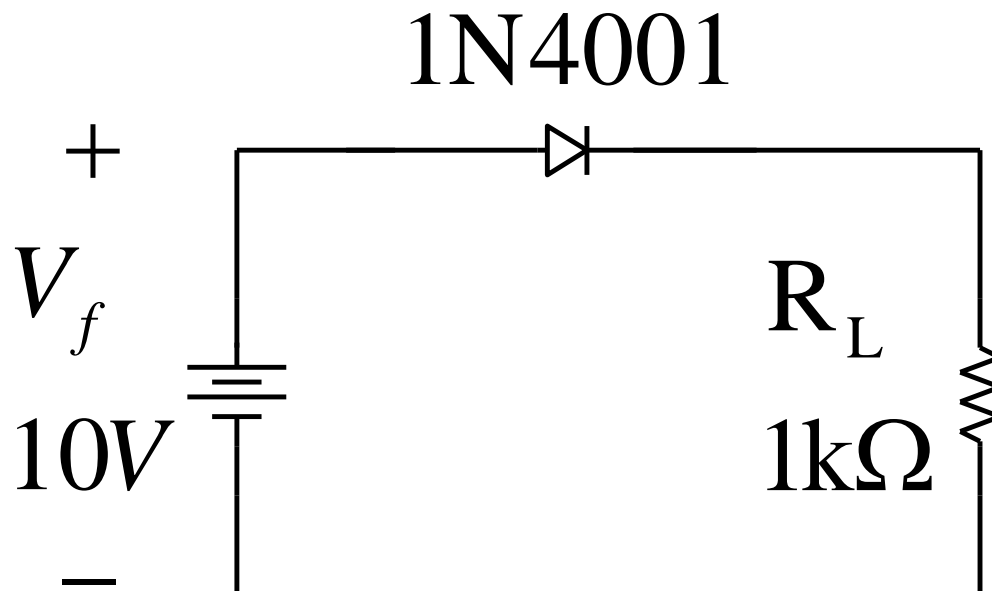
Modelo ideal do diodo



Modelo ideal do diodo

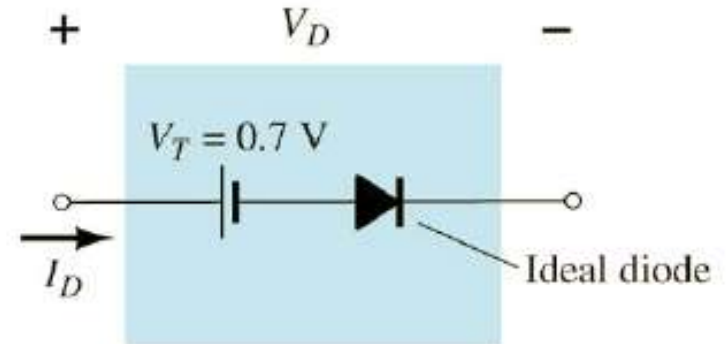
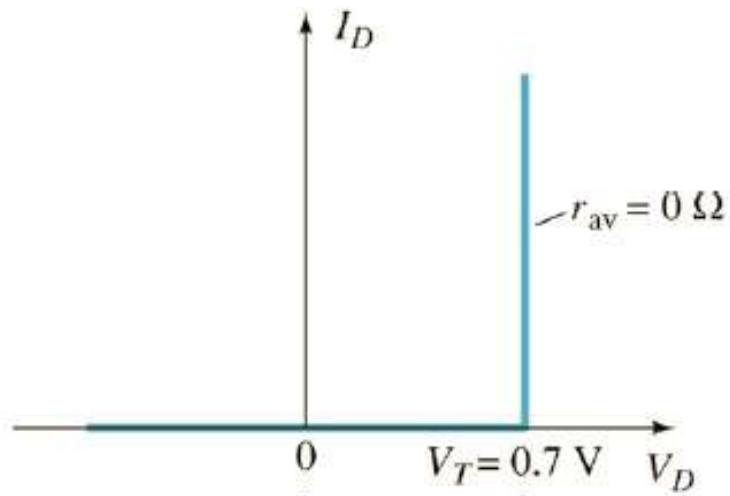
Exemplo 3.4 – Eletrônica, vol. 1:

- Use a aproximação do diodo ideal para calcular a corrente de carga, a tensão na carga, a potência na carga, a potência no diodo e a potência total no circuito da figura abaixo.



Exemplo 3.4 do Malvino.

Modelo simplificado do diodo

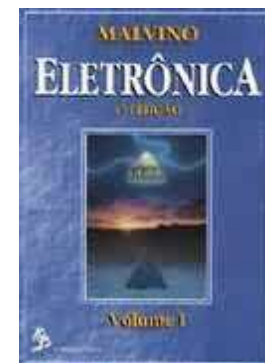
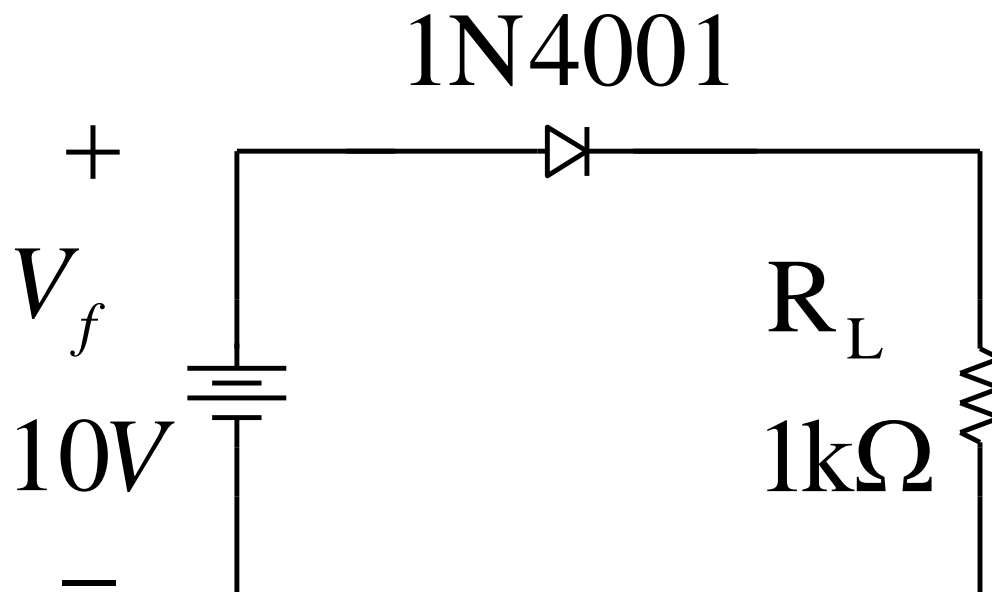


Exemplo 3.5 do Malvino.

Modelo simplificado do diodo

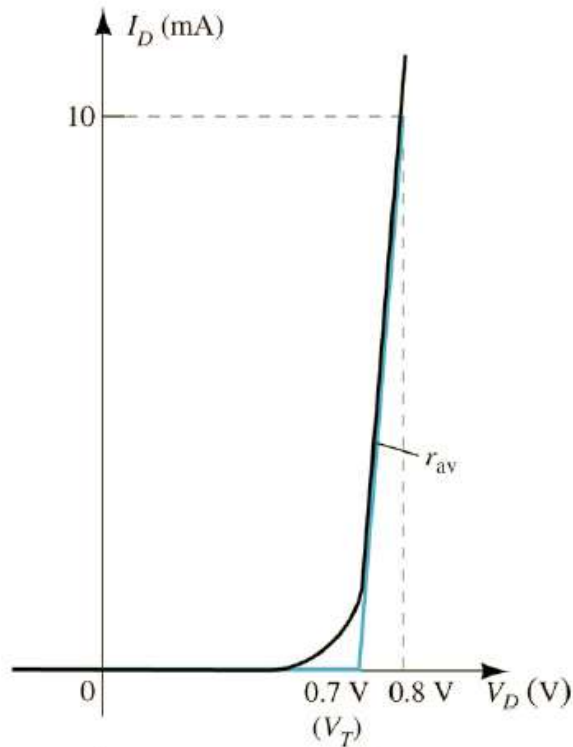
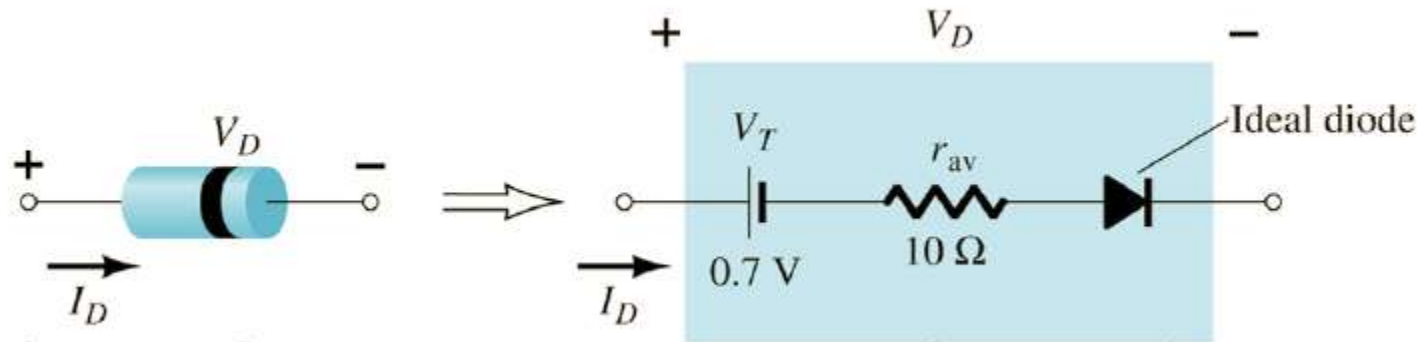
Exemplo 3.5 – Eletrônica, vol. 1:

- Use a segunda aproximação para calcular a corrente na carga, a tensão na carga, a potência na carga, a potência no diodo e a potência total para o circuito abaixo.



Exemplo 3.5 do Malvino.

Modelo linear por partes do diodo

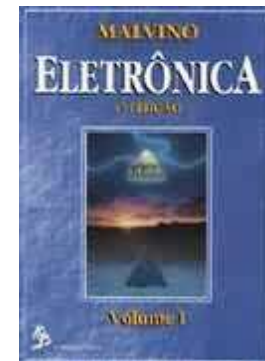
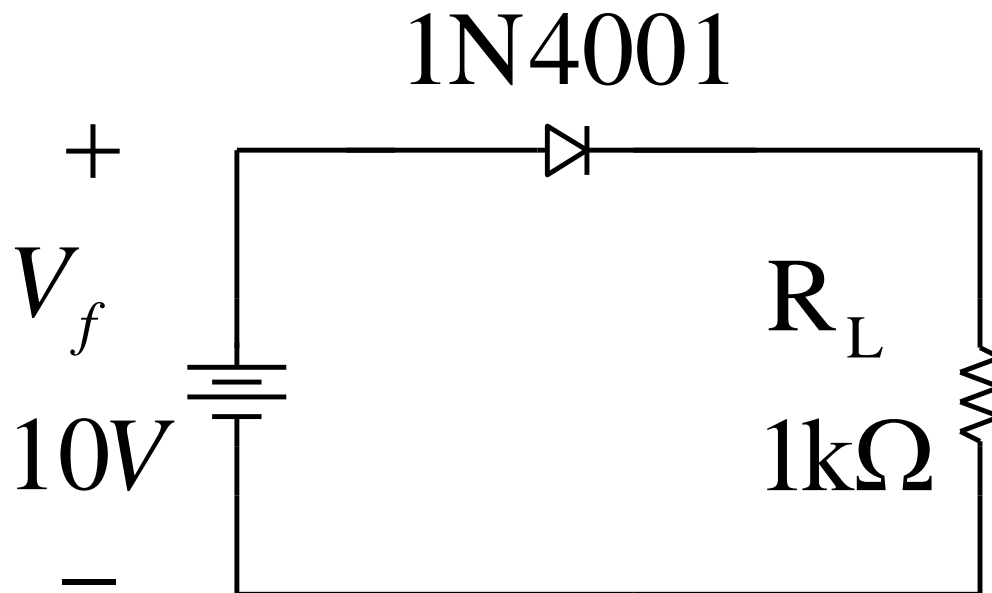


Exemplo 3.6 do Malvino.

Modelo linear por partes do diodo

Exemplo 3.6 – Eletrônica, vol. 1:

- Use a terceira aproximação para calcular a corrente na carga, a tensão na carga, a potência na carga, a potência no diodo e a potência total para o circuito abaixo. A resistência de corpo do diodo 1N4001 é $0,23\Omega$.



Exemplo 3.6 do Malvino.

Características dos diodos

As principais características (grandezas) são:

1. Corrente máxima direta (I_F ou I_o);
2. Tensão de ruptura reversa:
 - VRRM = Tensão de pico inverso repetitivo;
 - VRWM = Tensão de pico inverso de trabalho;
 - VR = Tensão de bloqueio CC.
3. Queda de tensão direta (v_F);
4. Corrente reversa máxima (I_R).
5. Entre outras

Características dos diodos

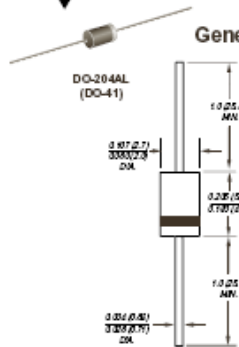


1N4001 thru 1N4007

Vishay Semiconductors
formerly General Semiconductor

General Purpose Plastic Rectifier

Reverse Voltage
50 to 1000V
Forward Current 1.0A



Features

- Plastic package has Underwriters Laboratories Flammability Classification 94V-0
- Construction utilizes void-free molded plastic technique
- Low reverse leakage
- High forward surge capability
- High temperature soldering guaranteed 350°C/10 seconds, 0.375" (9.5mm) lead length, 5 lbs. (2.3kg) tension

Mechanical Data

Case: JEDEC DO-204AL, molded plastic body
Terminals: Plated axial leads, solderable per MIL-STD-750, Method 2026
Polarity: Color band denotes cathode and
Mounting Position: Any
Weight: 0.012 oz., 0.3 g

Maximum Ratings & Thermal Characteristics

Parameter	Symb.	Rating at 25°C ambient temperature unless otherwise specified.							Unit
		1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	
Maximum repetitive peak reverse voltage	V_{RRM}	50	100	200	400	600	800	1000	V
* Maximum RMS voltage	V_{RMS}	35	70	140	280	420	560	700	V
* Maximum DC blocking voltage	V_{DC}	50	100	200	400	600	800	1000	V
* Maximum average forward rectified current 0.375" (9.5mm) lead length at $T_A = 75^\circ\text{C}$	$I_{F(AV)}$	1.0							A
* Peak forward surge current 8.3ms single half sine-wave superimposed on rated load (JEDEC Method) $T_A = 75^\circ\text{C}$	I_{FSM}	30							A
* Maximum full load reverse current, full cycle average 0.375" (9.5mm) lead length $T_A = 75^\circ\text{C}$	$I_{R(AV)}$	30							μA
Typical thermal resistance ⁽¹⁾	$R_{\theta JA}$ $R_{\theta CL}$	50 25							*°CW
* Maximum DC blocking voltage temperature	T_A	+150							V
* Operating junction and storage temperature range	T_J, T_{STG}	-50 to +175							*°C

Electrical Characteristics			
Rating at 25°C ambient temperature unless otherwise specified.			
Maximum instantaneous forward voltage at 1.0A	V_F	1.1	
* Maximum DC reverse current at rated DC blocking voltage $T_A = 25^\circ\text{C}$ $T_A = 125^\circ\text{C}$	I_R	5.0 50	μA
Typical junction capacitance at 4.0V, 1MHz	C_J	15	

Note: (1) Thermal resistance from junction to ambient at 0.375" (9.5mm) lead length, P.C.B. mounted *JEDEC registered value

Subsite: PD-20731 rev. C 12/03

International
IR Rectifier

Ultrafast Rectifier

MUR820
MURB820
MURB820-1

Features

- Ultrafast Recovery Time
- Low Forward Voltage Drop
- Low Leakage Current
- 175°C Operating Junction Temperature

$t_r = 25\text{ns}$
 $I_{F(AV)} = 8\text{Amp}$
 $V_{RRM} = 200\text{V}$

Description/Applications

International Rectifier's MUR series are the state of the art ultra fast recovery rectifiers specifically designed with optimized performance of forward voltage drop and ultra fast recovery time. The planar structure and the platinum top electrode control, guarantee the best overall performance, ruggedness and reliability characteristics. These devices are intended for use in the output rectification stage of 2MP, UPS, DC-DC converters as well as free-wheeling diode in low voltage inverters and stepper motor drives. Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and substrates.

Absolute Maximum Ratings

Parameters	Max	Units
V_{RRM} Peak Repetitive Peak Reverse Voltage	200	V
$I_{F(AV)}$ Average Rectified Forward Current Total Device, (Rated V_F), $T_J = 150^\circ\text{C}$	8	A
I_{FSM} Non Repetitive Peak Surge Current	100	
I_{RM} Peak Repetitive Reverse Current (Rated V_R , Square wave, 20 kHz), $T_J = 150^\circ\text{C}$	10	
T_J, T_{STG} Operating Junction and Storage Temperature	-55 to 175	°C



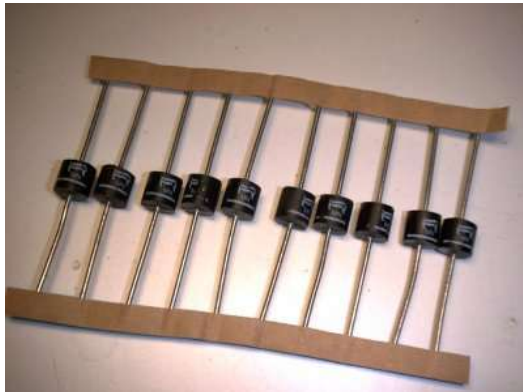
Características dos diodos



Diodos de potência



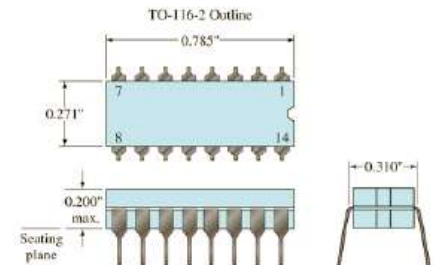
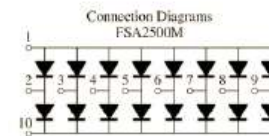
Diodos de sinal



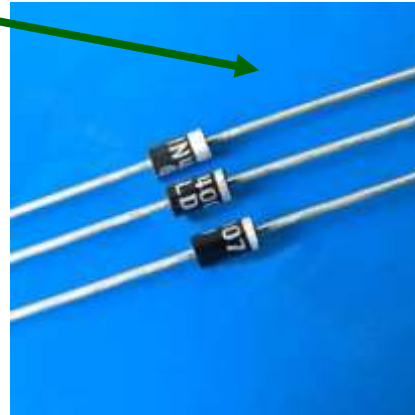
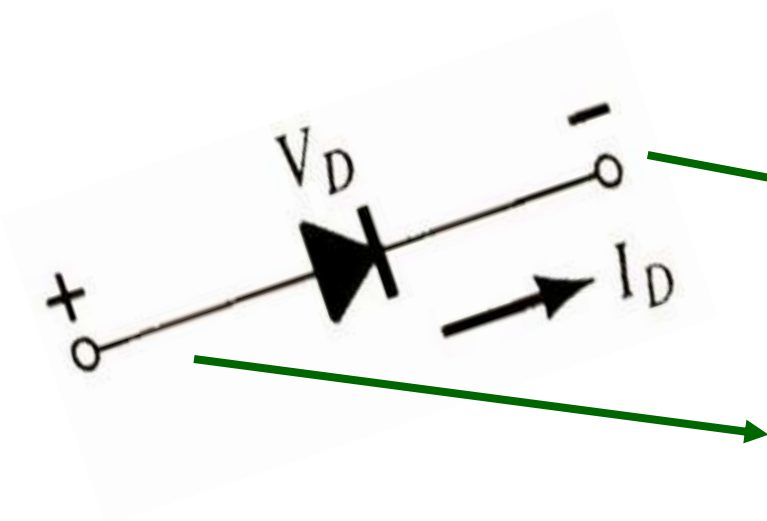
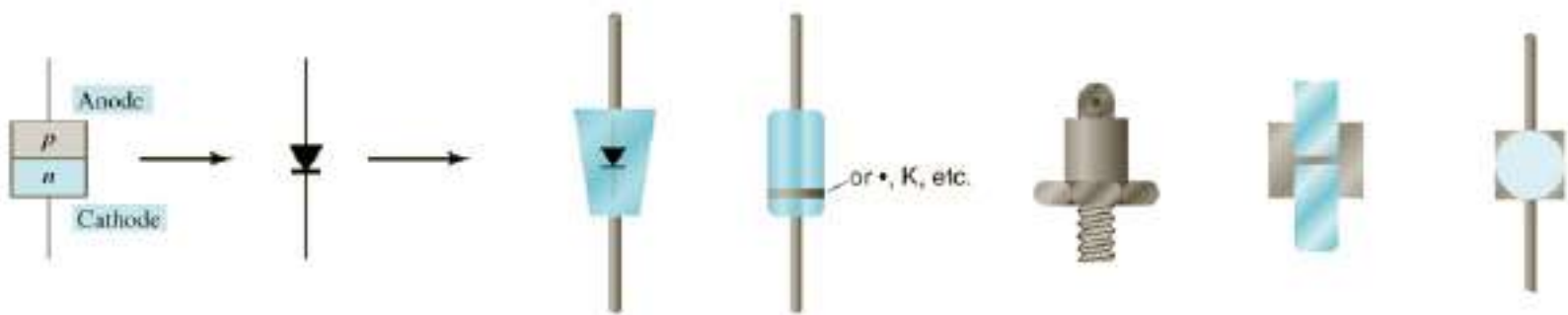
Diodos de uso geral



Circuitos integrados de diodos



Identificação dos terminais de um diodo



Testando diodos com o multímetro



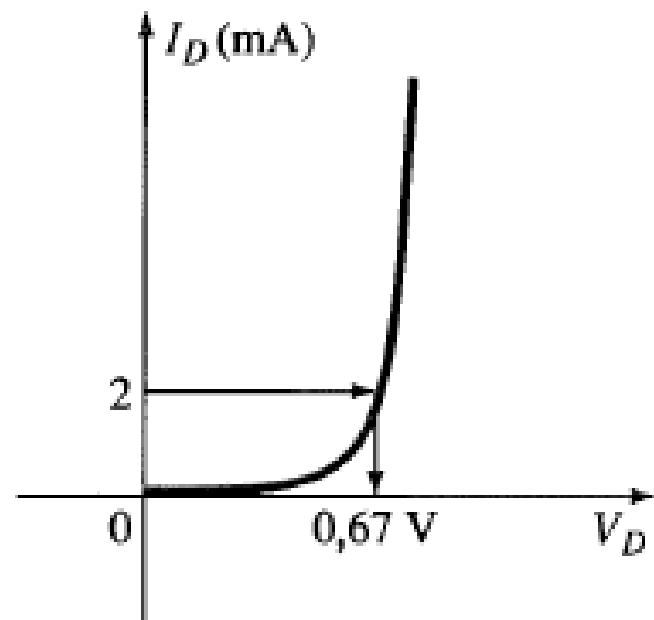
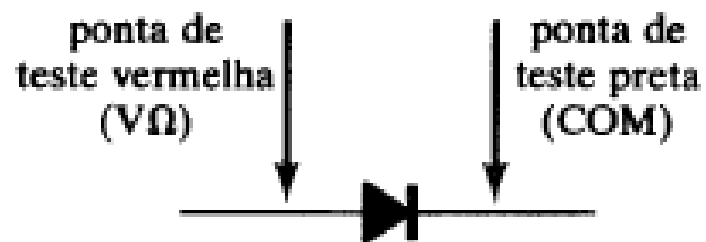
Escala para teste de diodos



Escala para teste de diodos

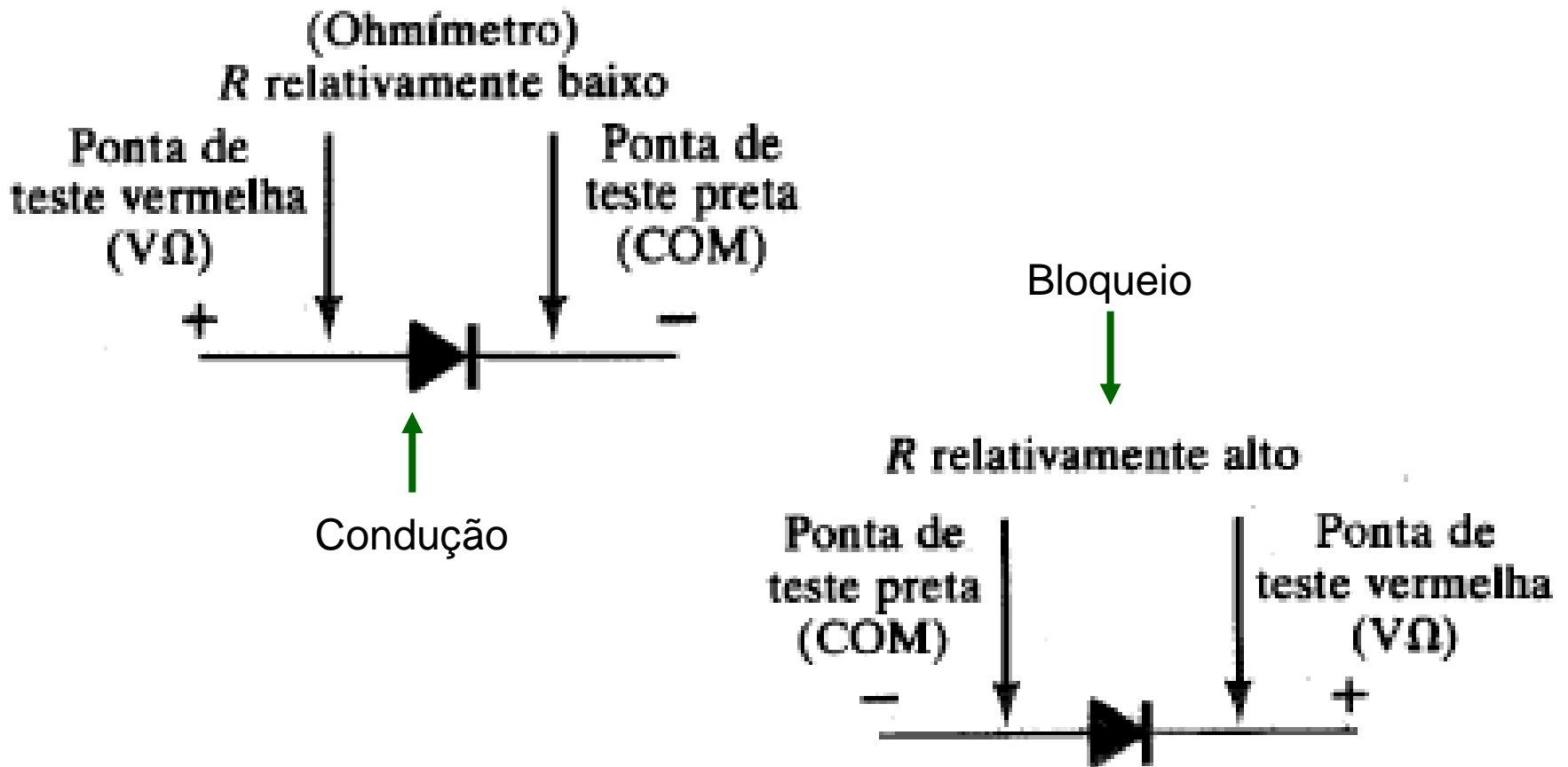
Testando diodos com o multímetro

Polarização direta:



Testando diodos com o multímetro

Testes com ohmímetro:

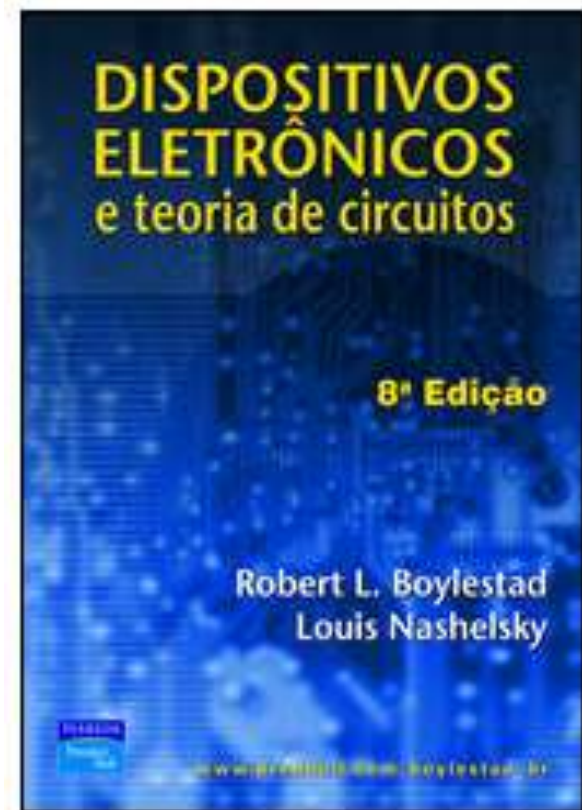


Na próxima aula

Capítulo 1: Diodos semicondutores

1. Laboratório:

- Identificação de diodos;
- Testes de diodos com multímetro.



www.cefetsc.edu.br/~petry