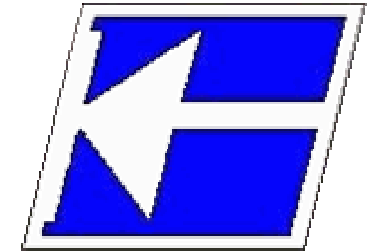


**Centro Federal de Educação Tecnológica de Santa Catarina**

**Departamento de Eletrônica**

**Curso Superior de Sistemas Digitais**

**Retificadores**

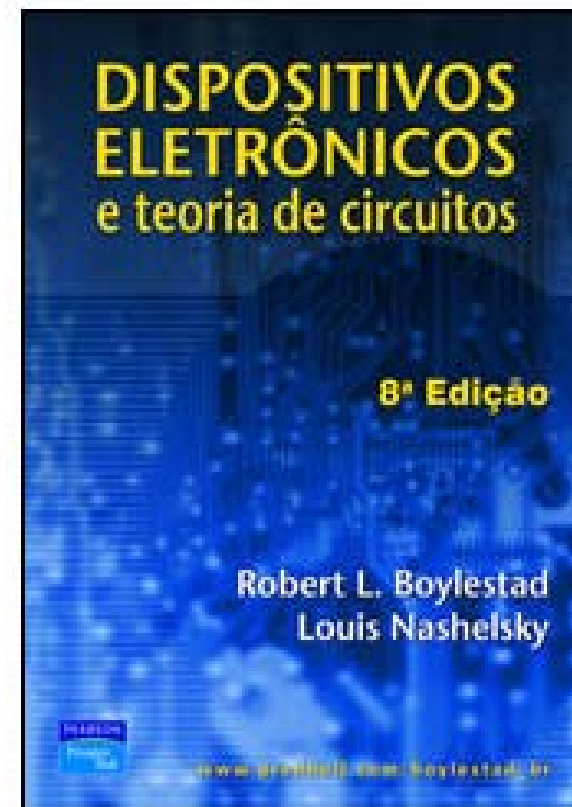
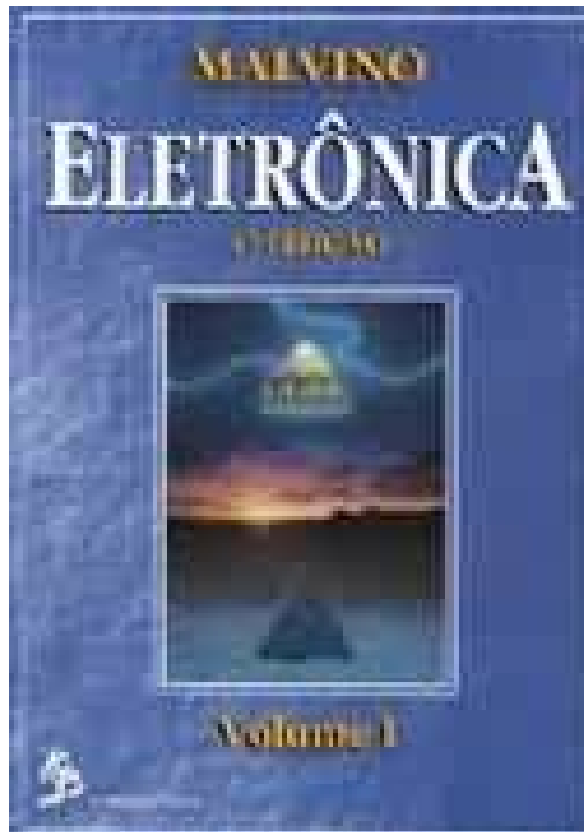


# **Características dos diodos**

**Prof. Clóvis Antônio Petry.**

**Florianópolis, maio de 2007.**

## Bibliografia para esta aula



## Nesta aula

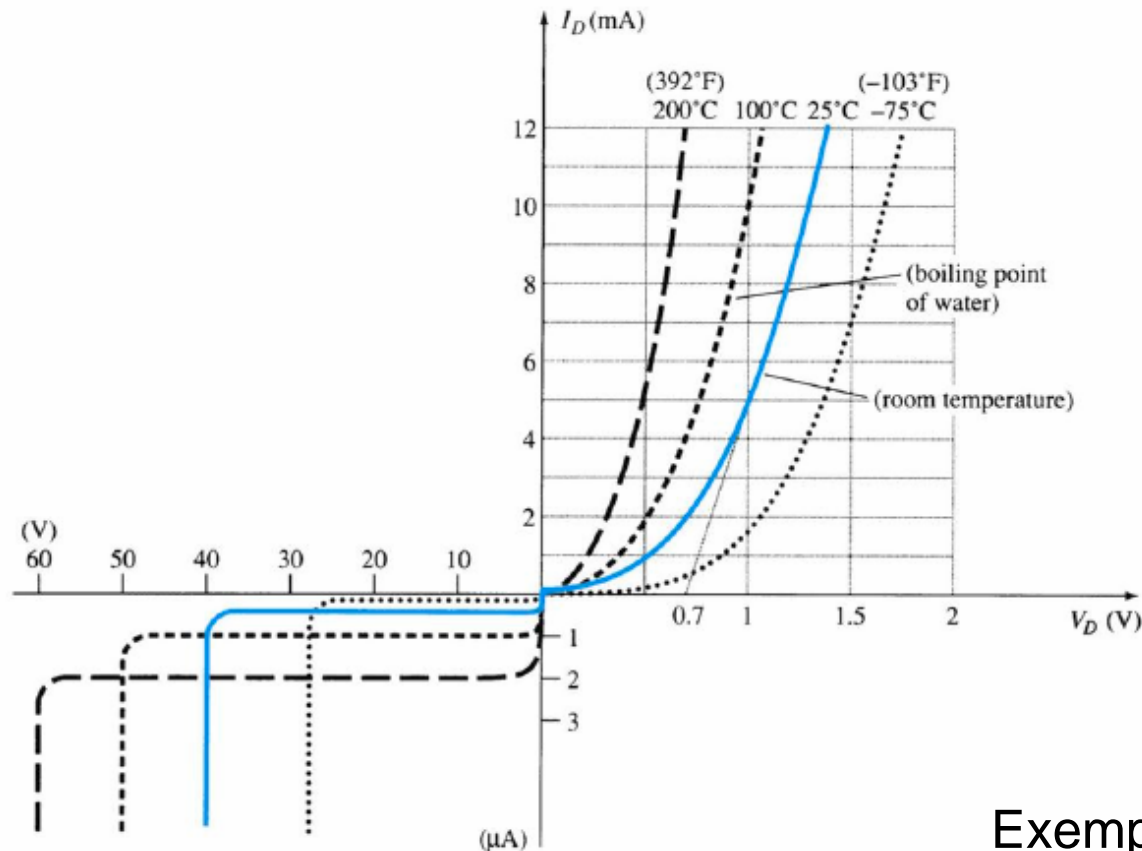
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### **Seqüência de conteúdos:**

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.

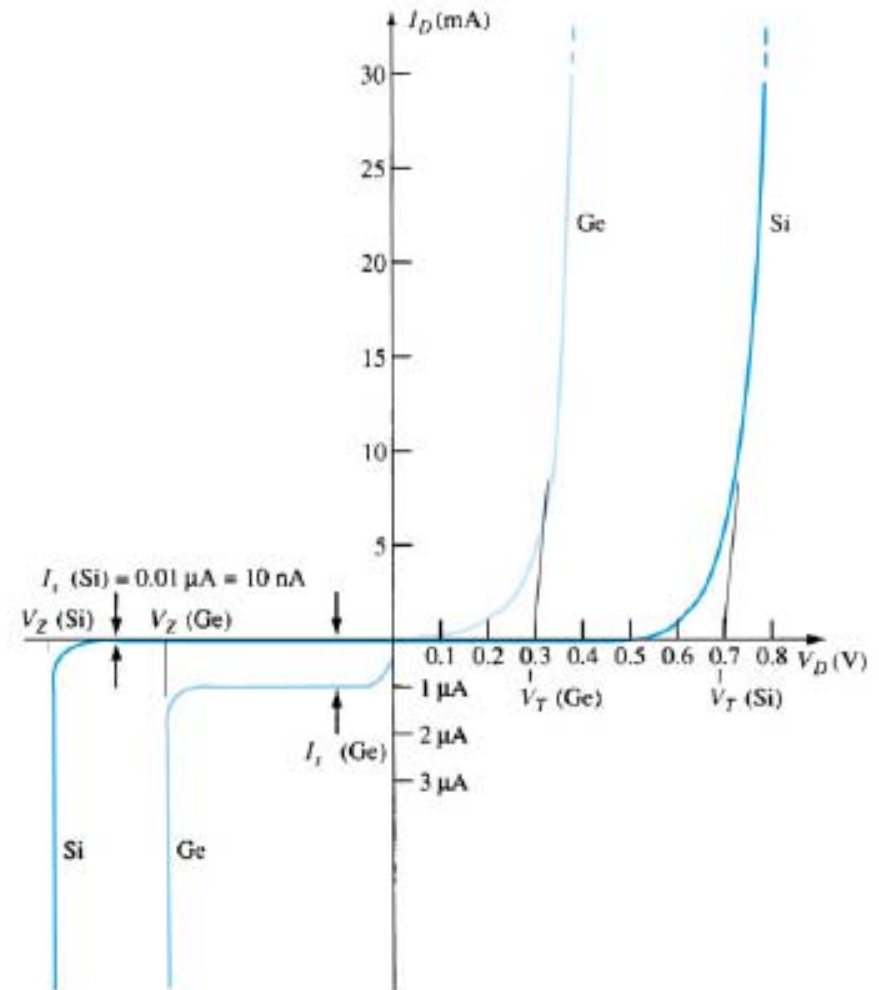
# Efeito da temperatura na junção P-N

A corrente de saturação reversa  $I_S$  terá sua amplitude praticamente dobrada para aumento de  $10\text{ }^\circ\text{C}$  na temperatura.

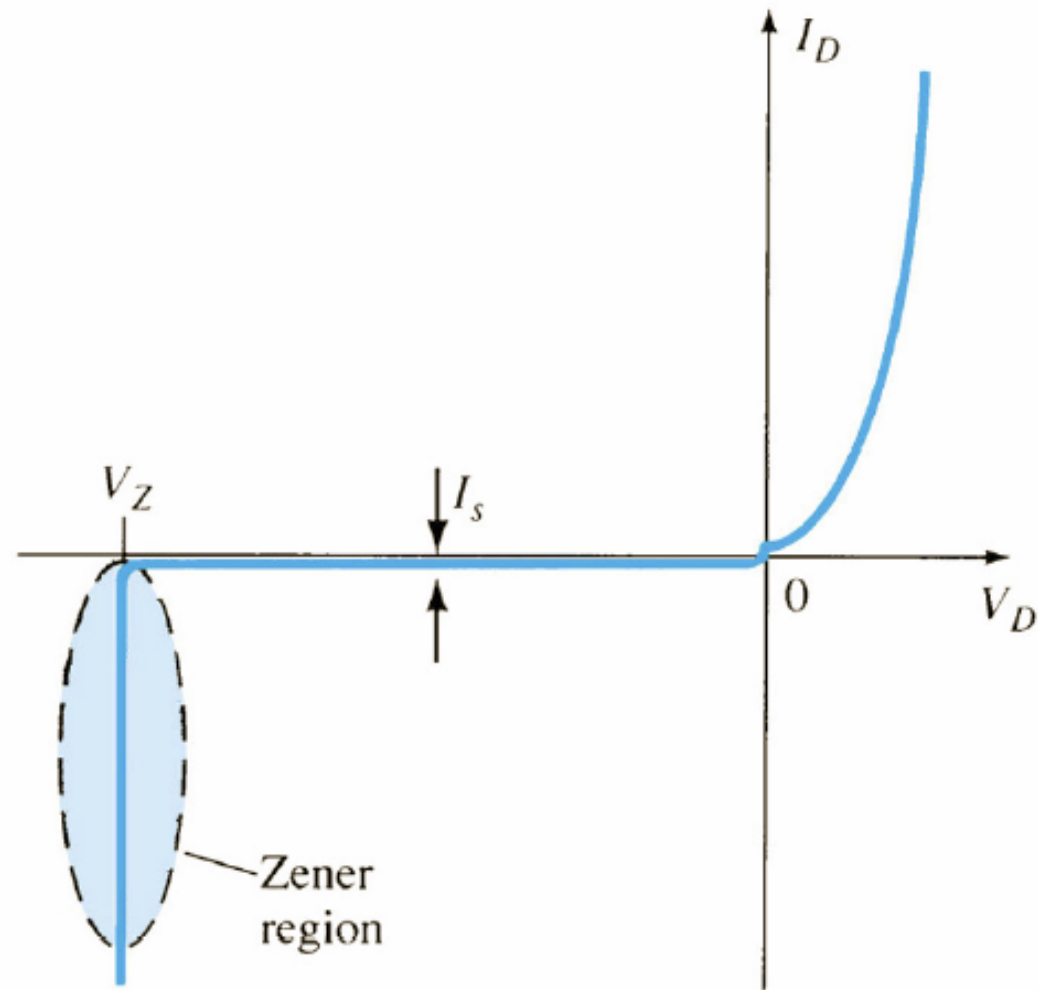


# Silício versus germânio

- 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.



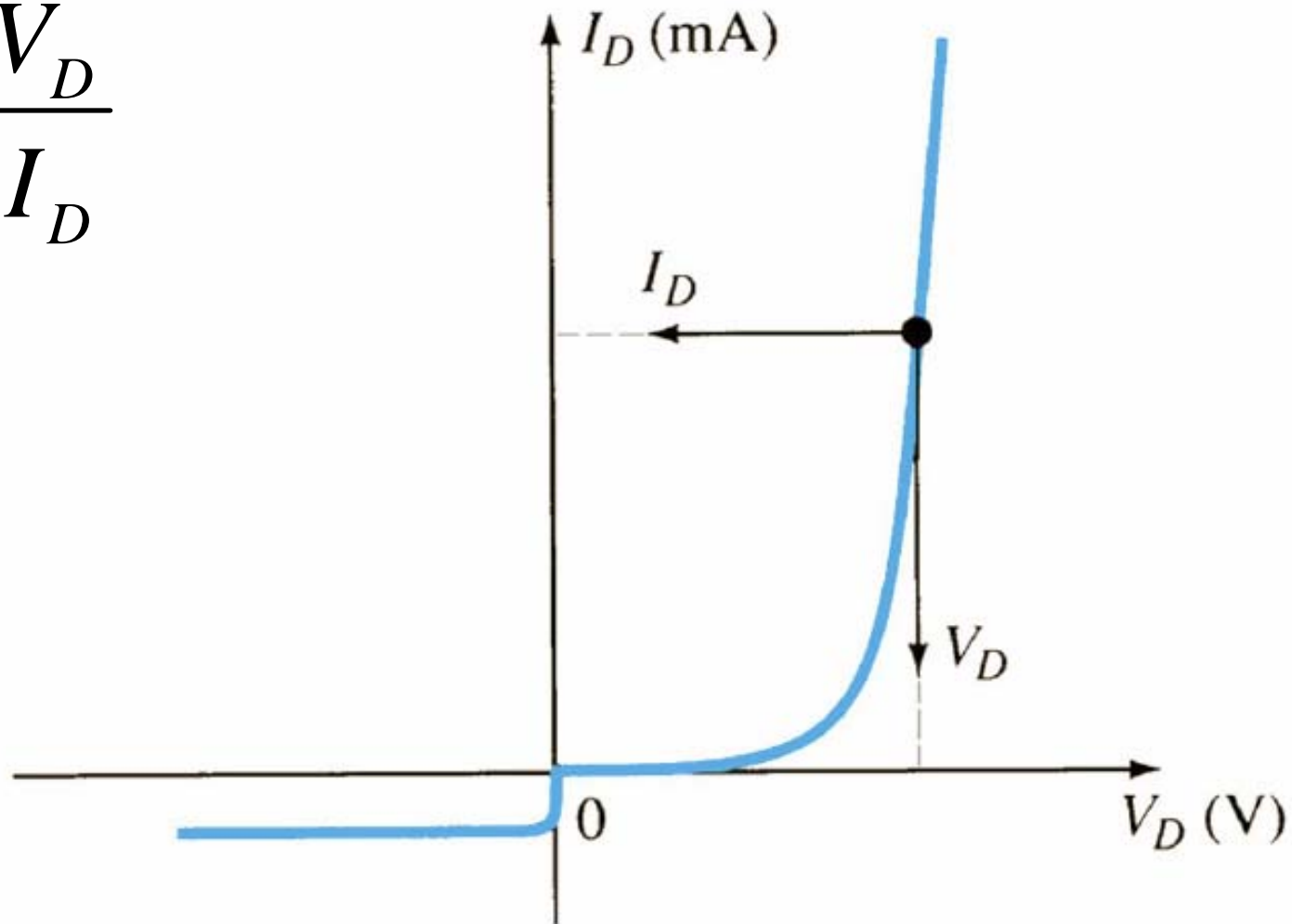
# Diodo – Região zener



# Resistências do diodo

Resistência CC ou estática:

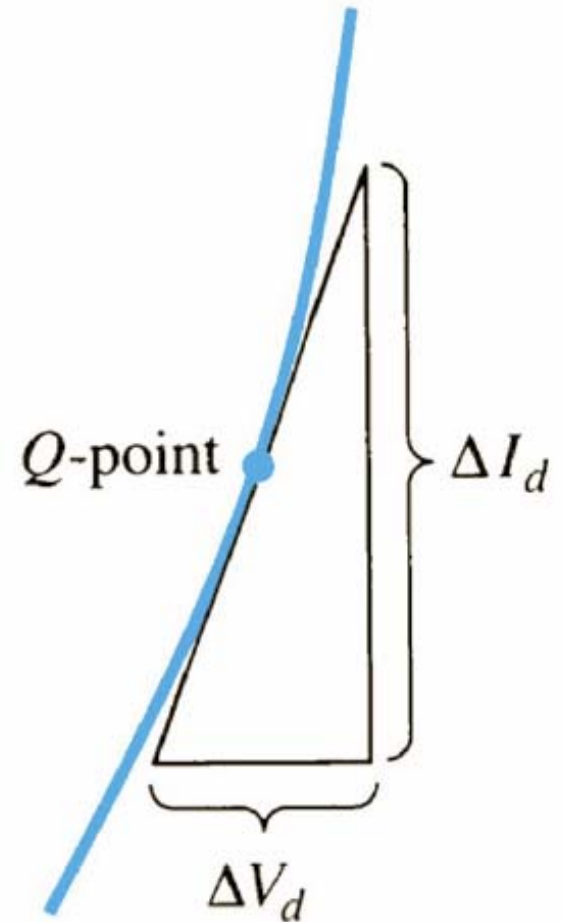
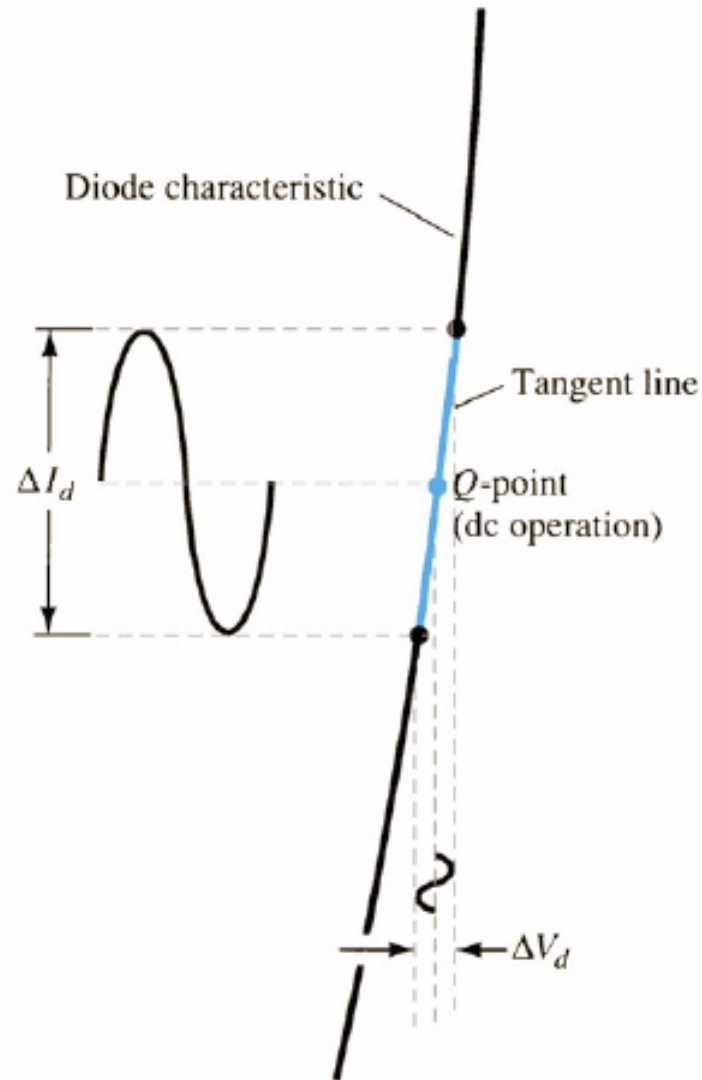
$$R_D = \frac{V_D}{I_D}$$



# Resistências do diodo

Resistência CA ou dinâmica:

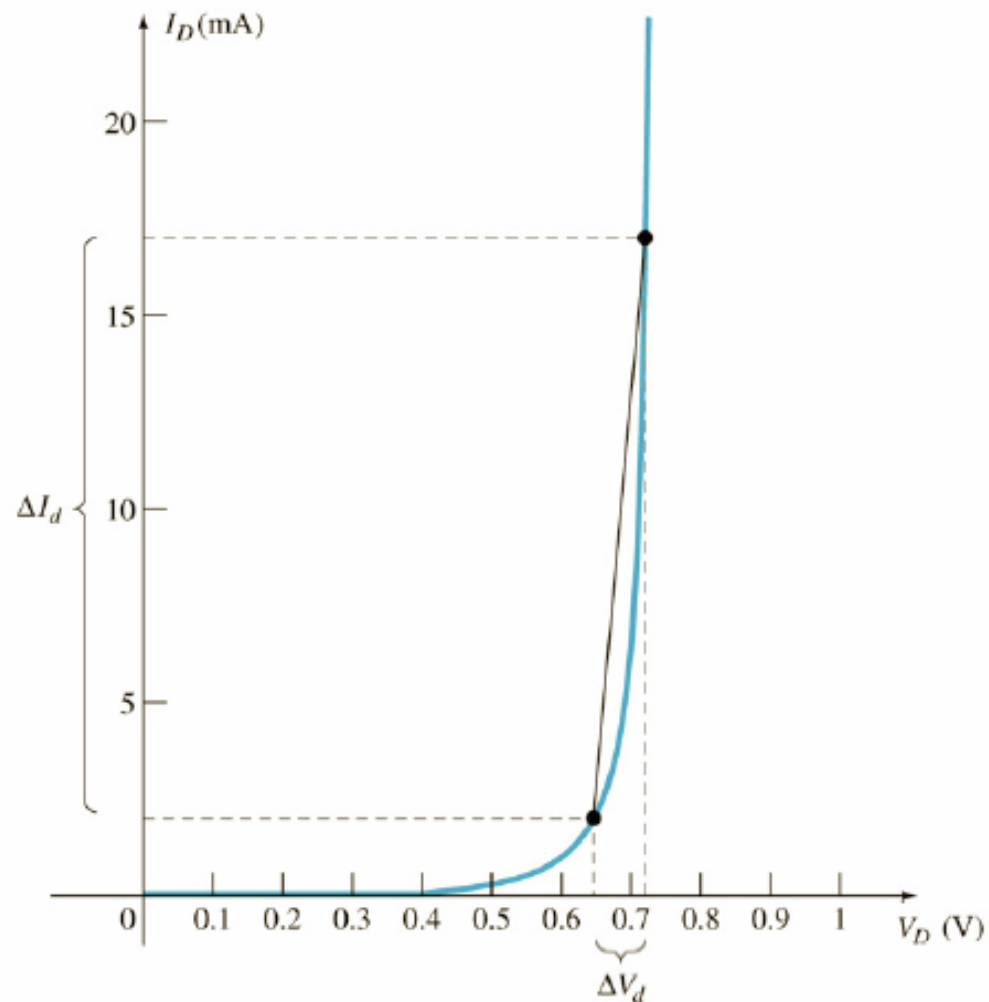
$$r_D = \frac{\Delta V_D}{\Delta I_D}$$



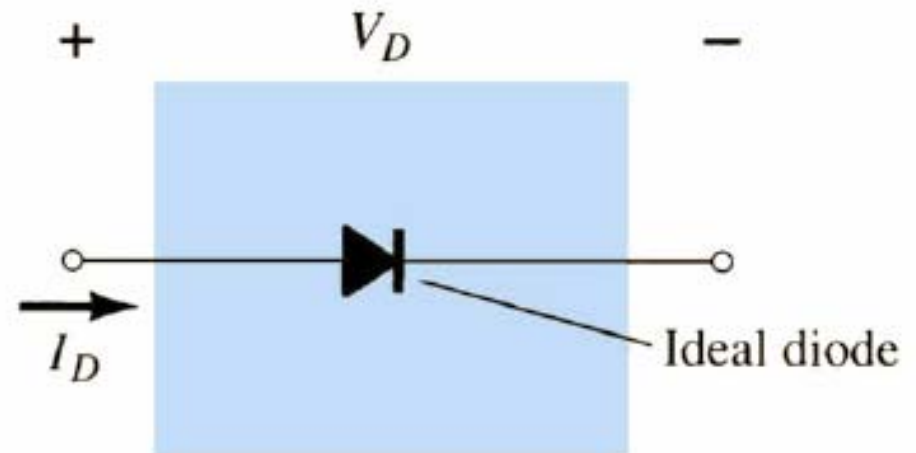
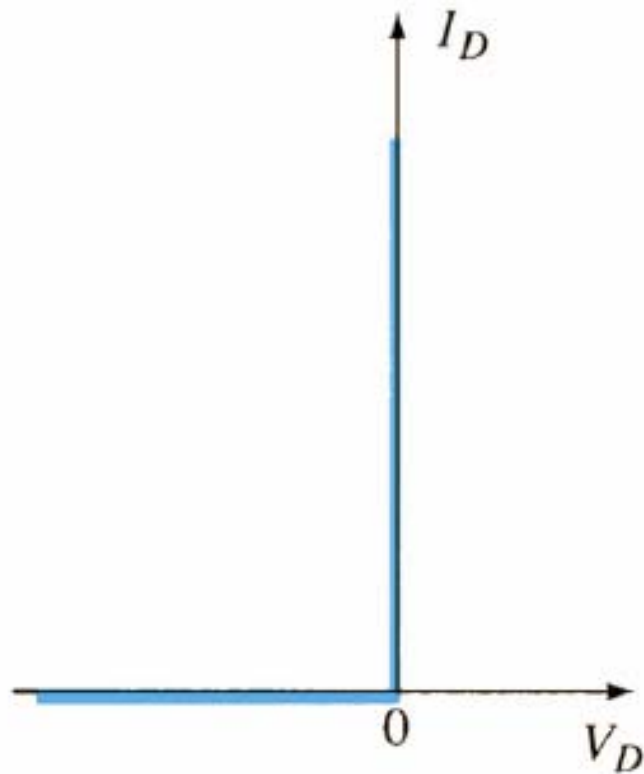
# Resistências do diodo

Resistência CA média ou resistência de corpo:

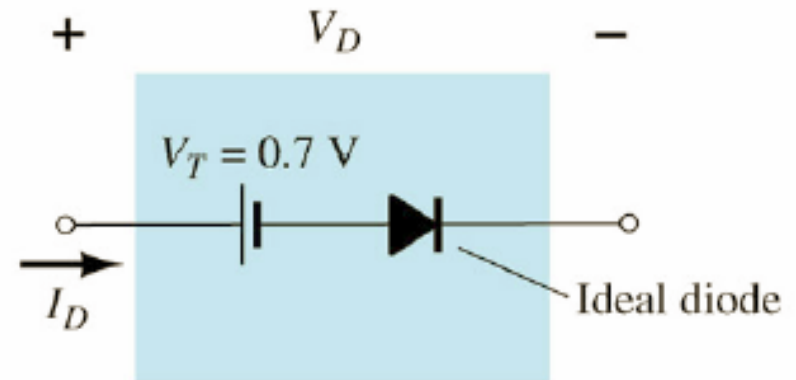
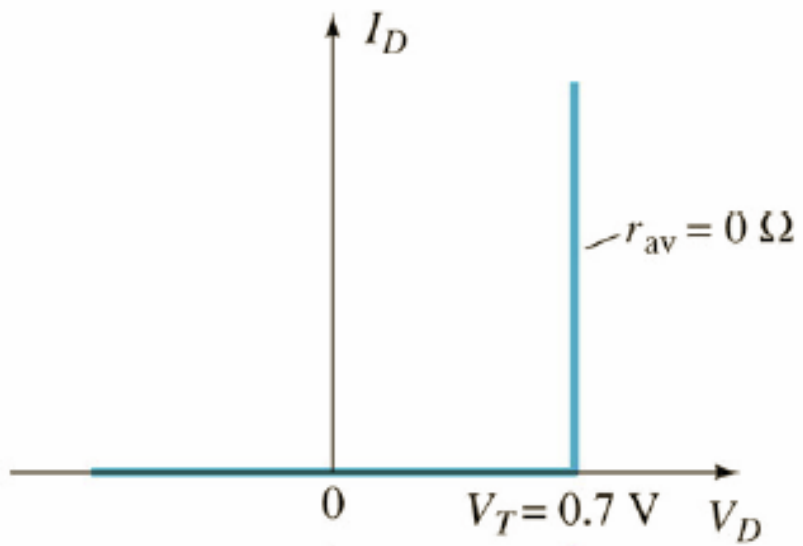
$$r_{av} = \frac{\Delta V_d}{\Delta I_d}$$



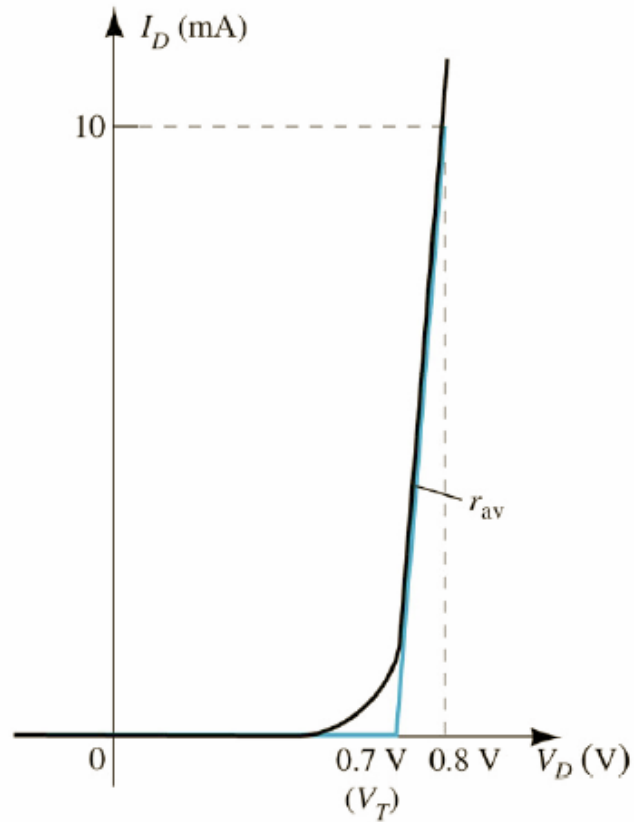
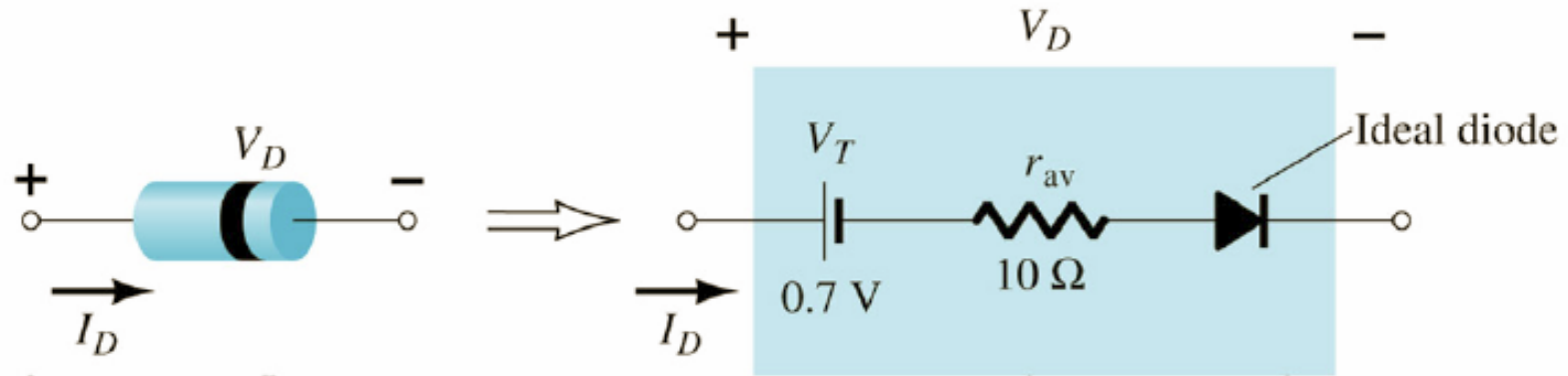
# Modelo ideal do diodo



# Modelo simplificado do diodo



# Modelo linear por partes do diodo



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

**VISHAY**

**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

Dimensions in inches and (millimeters)

## Maximum Ratings & Thermal Characteristics

Parameter	Symb.	Ratings 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 $T_L = 75^\circ\text{C}$	$I_{R(AV)}$	30							$\mu\text{A}$
Typical thermal resistance <sup>(1)</sup>	$R_{\theta JA}$ $R_{\theta AL}$	50 25							$^\circ\text{C/W}$
* Maximum DC blocking voltage temperature	$T_A$	+150							V
* Operating junction and storage temperature range	$T_J, T_{STG}$	-50 to +175							$^\circ\text{C}$

## Electrical Characteristics

Ratings at 25°C ambient temperature unless otherwise specified.				
Maximum instantaneous forward voltage at 1.0A	$V_f$	1.1		V
* 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		$\mu\text{A}$
Typical junction capacitance at 4.0V, 1MHz	$C_j$	15		pF

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

Bulletin PD-20731 rev. C 12/05

International  
**IR** Rectifier

**MUR820**  
**MURB820**  
**MURB820-1**

## Ultrafast Rectifier

### Features

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

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

### 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 doped life time control, guarantee the best overall performance, ruggedness and reliability characteristics. These devices are intended for use in the output rectification stage of SMPS, UPS, DC-DC converters as well as free-wheeling diode in low voltage inverters and chopper motor drives. Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

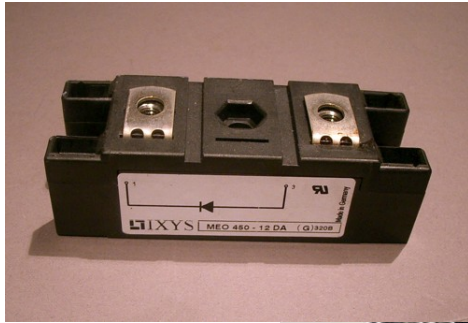
### Absolute Maximum Ratings

Parameters	Max.	Units
$V_{RRM}$ Peak Repetitive Peak Reverse Voltage	200	V
$I_{F(AV)}$ Average Rectified Forward Current Total Device, (Rated $V_f$ ), $T_C = 150^\circ\text{C}$	8	A
$I_{FSM}$ Non Repetitive Peak Surge Current	100	
$I_{RM}$ Peak Repetitive Forward Current (Rated $V_f$ , Square wave, 33 kHz), $T_C = 150^\circ\text{C}$	10	
$T_J, T_{STG}$ Operating Junction and Storage Temperature	-55 to 175	$^\circ\text{C}$

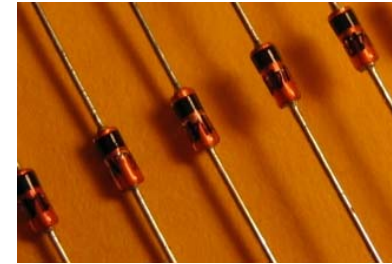
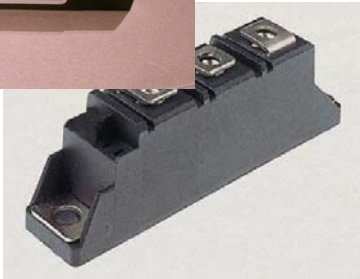
**Case Styles**

 TO-220AC	 DPAK	 TO-262
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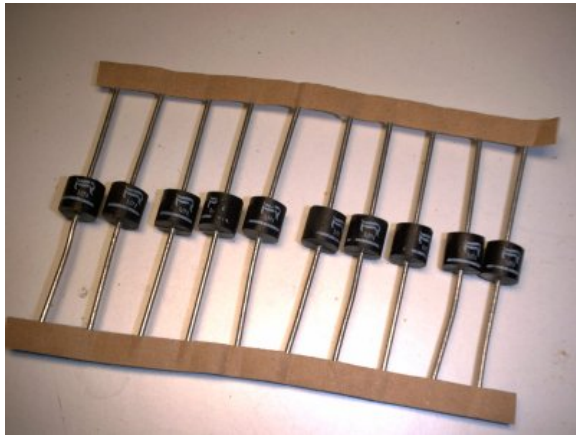
# Características dos diodos



Diodos de potência



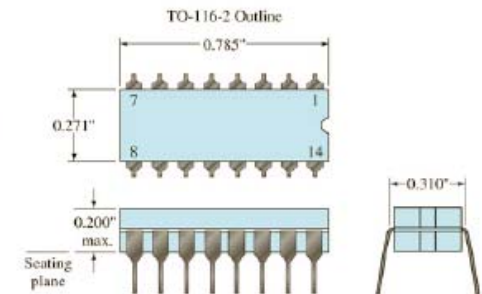
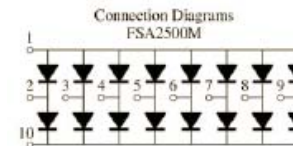
Diodos de sinal



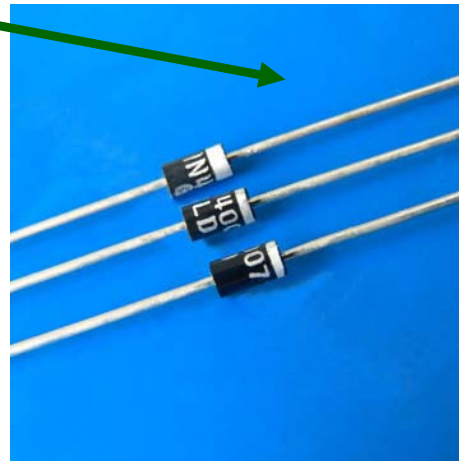
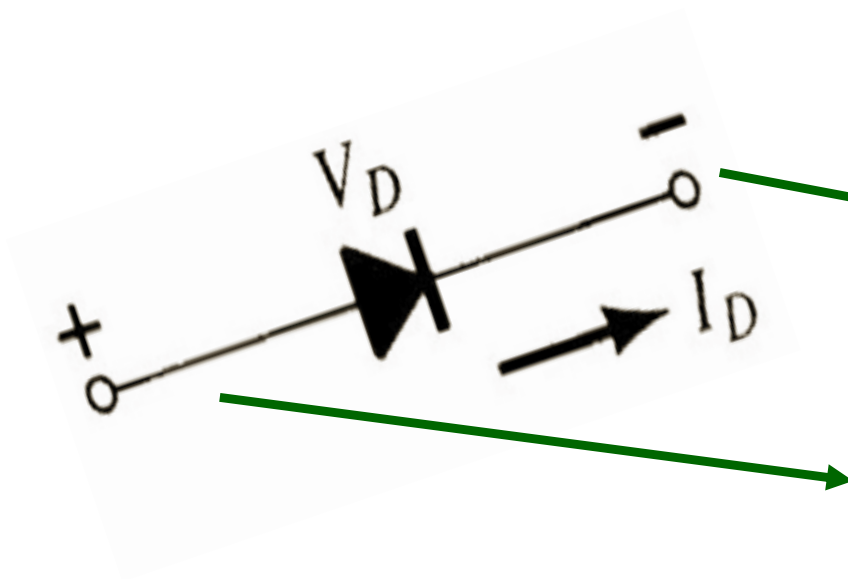
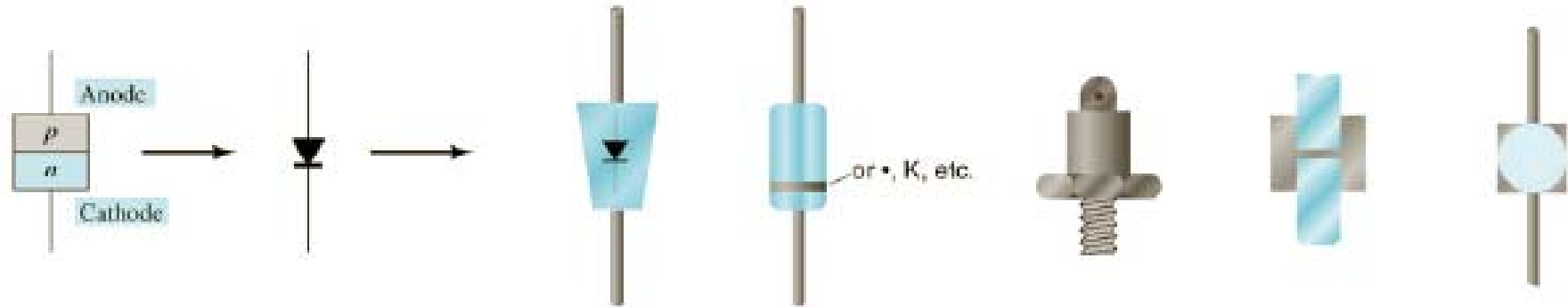
Diodos de uso geral



Circuitos integrados de diodos



# Identificação dos terminais de um diodo



# Testando diodos com o multímetro



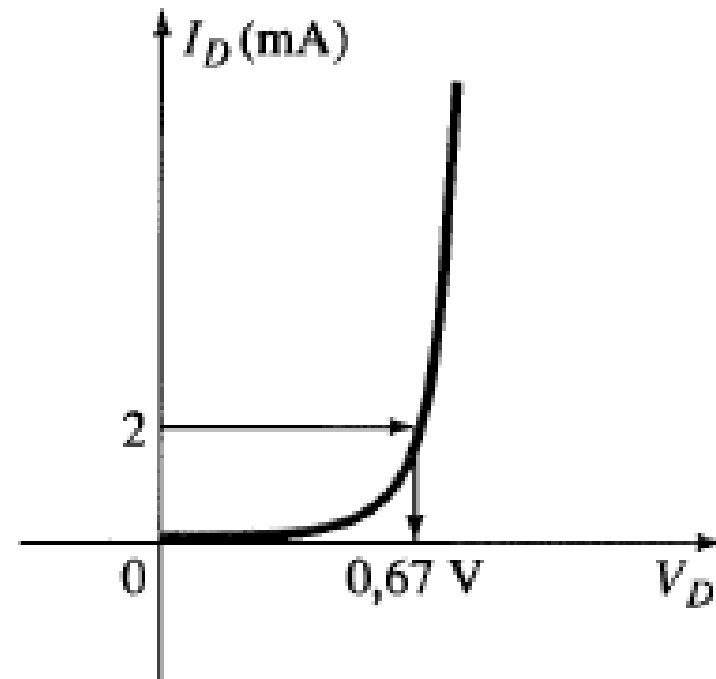
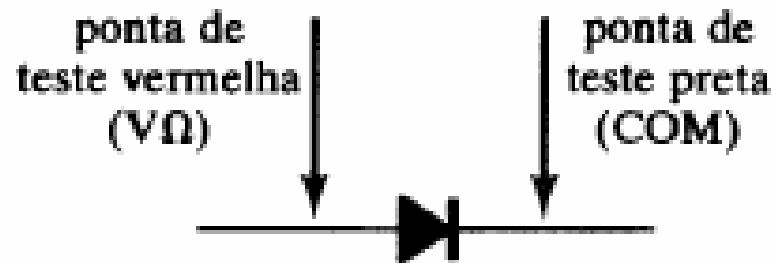
Escala para teste de diodos



Escala para teste de diodos

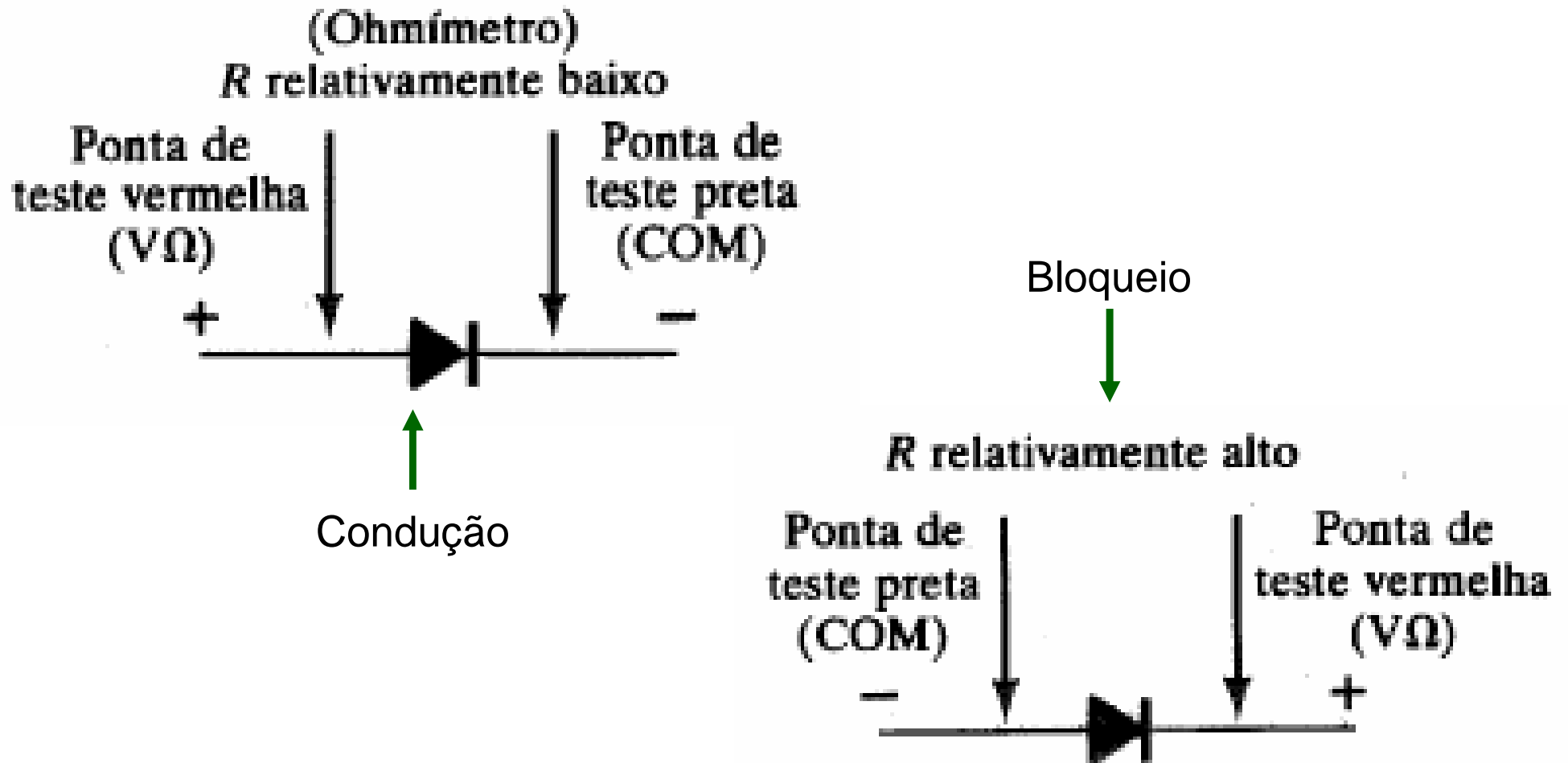
# Testando diodos com o multímetro

**Polarização direta:**



# Testando diodos com o multímetro

Testes com ohmímetro:



# Na próxima aula

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## **Seqüência de conteúdos:**

### 1. Aula de laboratório:

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