



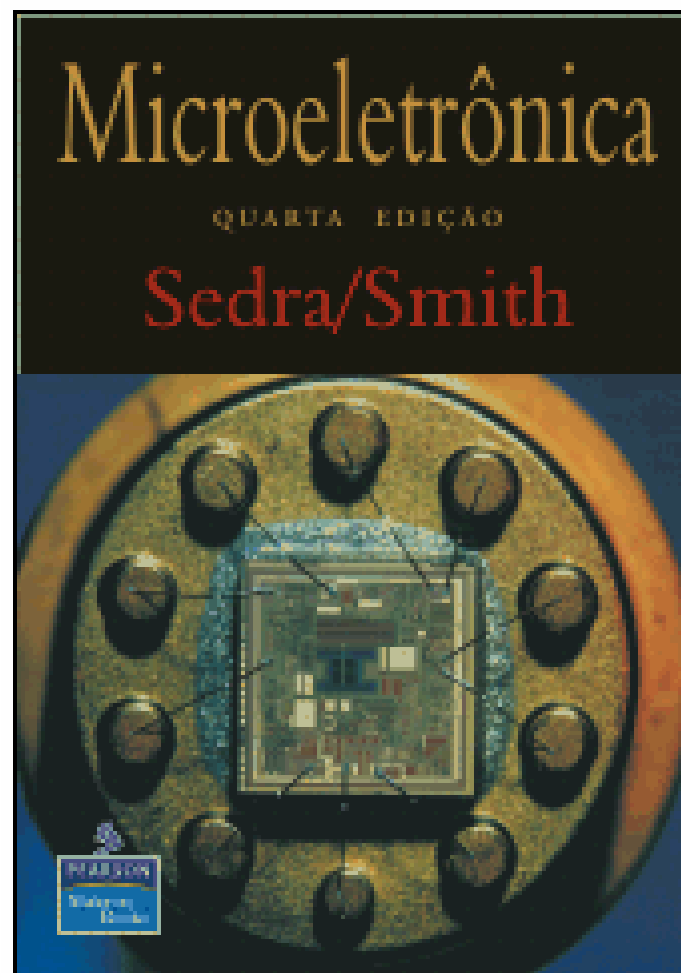
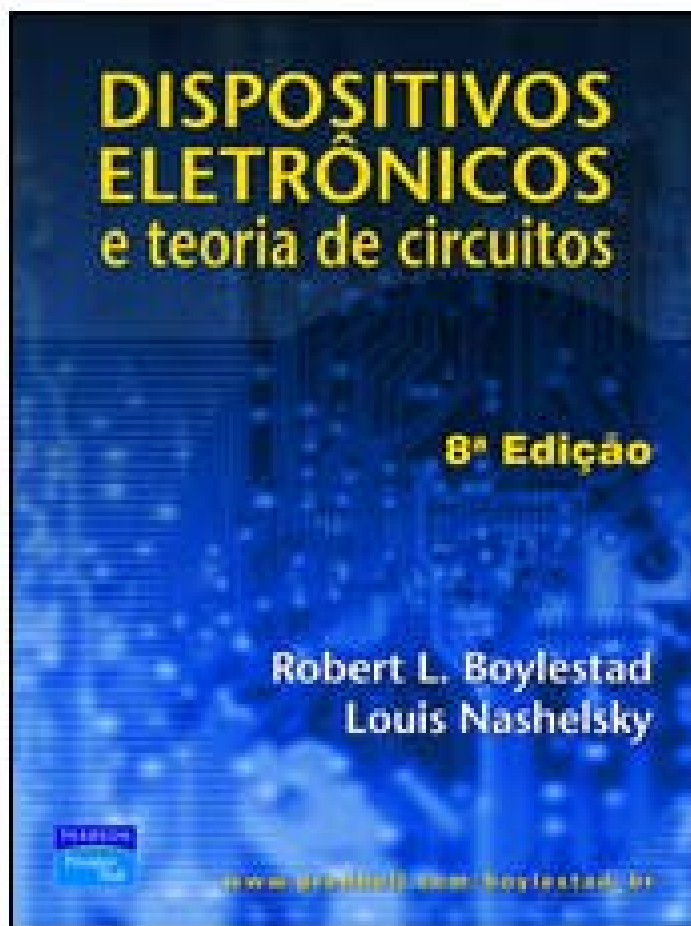
Universidade Federal de Santa Catarina
Departamento de Engenharia Elétrica
Materiais Elétricos - Laboratório

Junções PN e Fotodiodos

Clóvis Antônio Petry, professor.

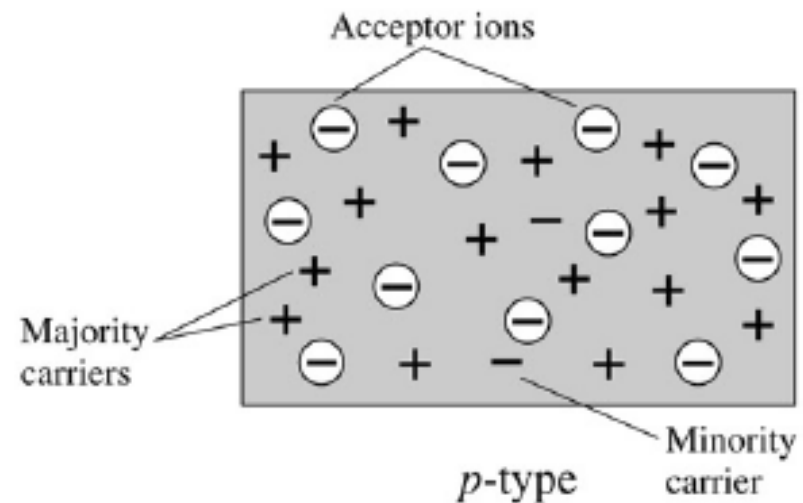
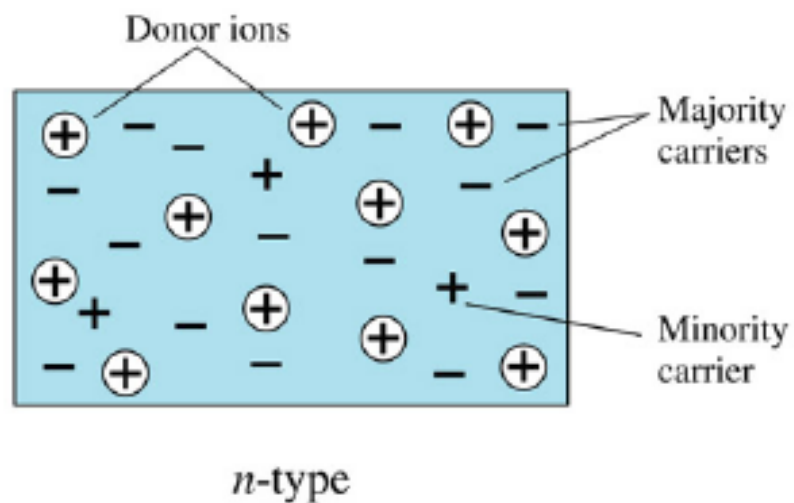
Florianópolis, agosto de 2006.

Semicondutores – referências bibliográficas

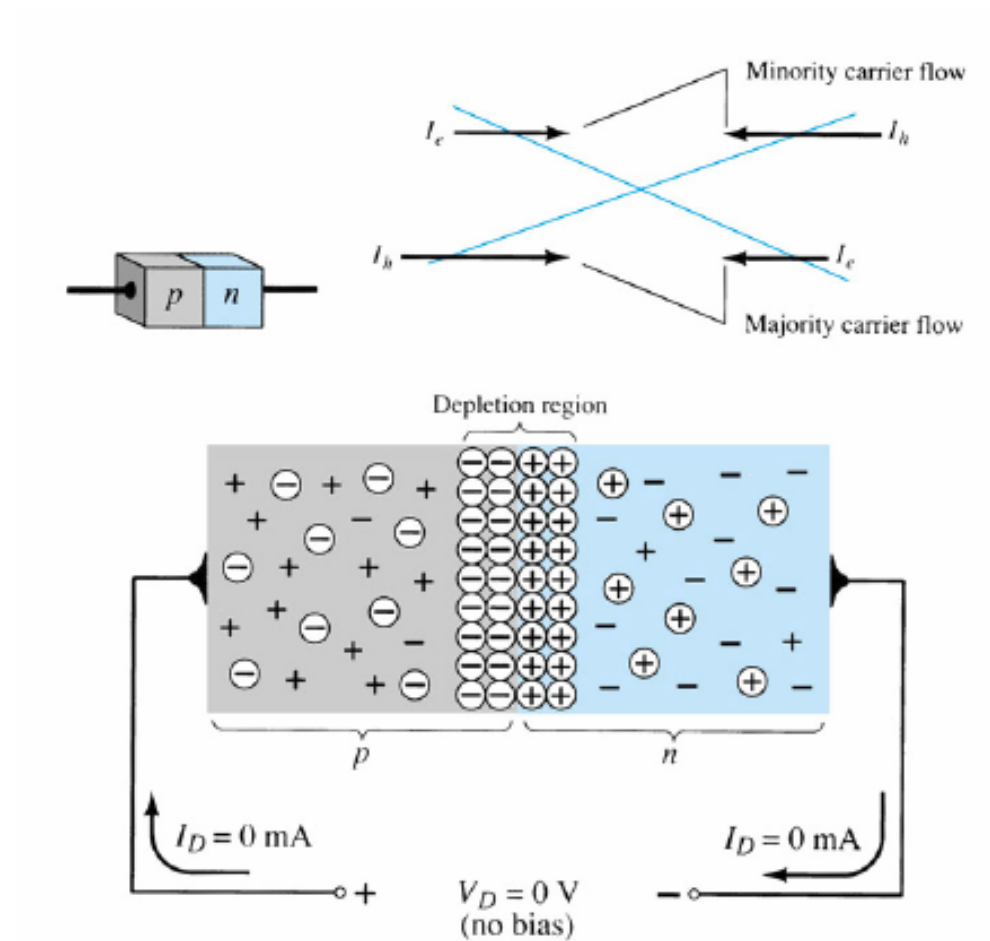


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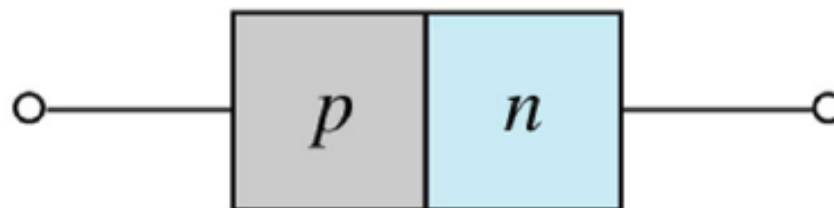
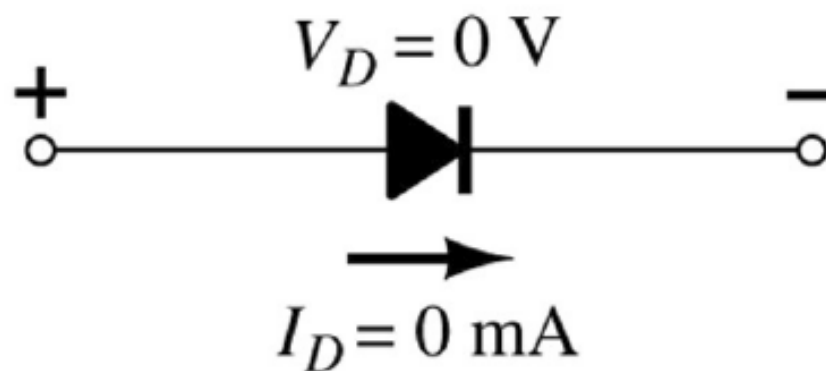
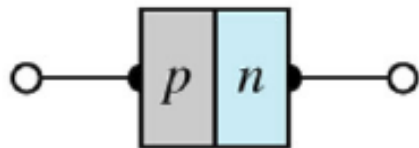
Semicondutores – materiais P e N



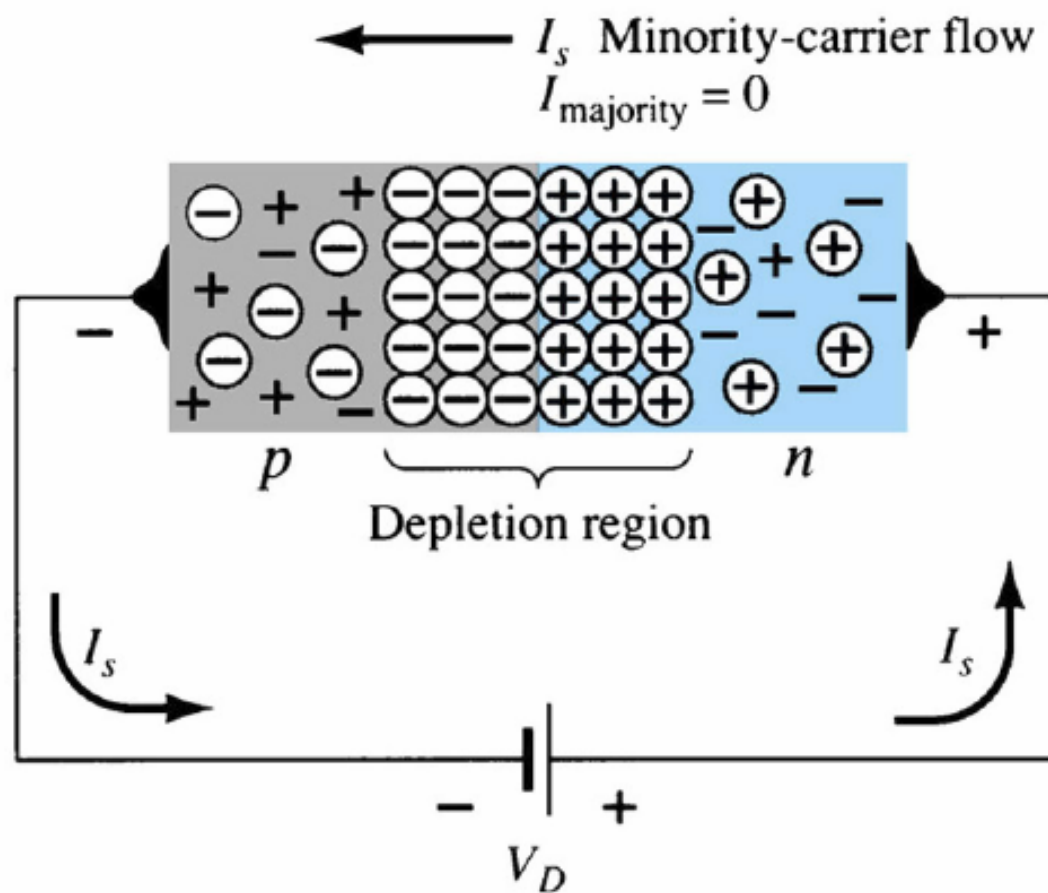
Junção PN – Sem polarização



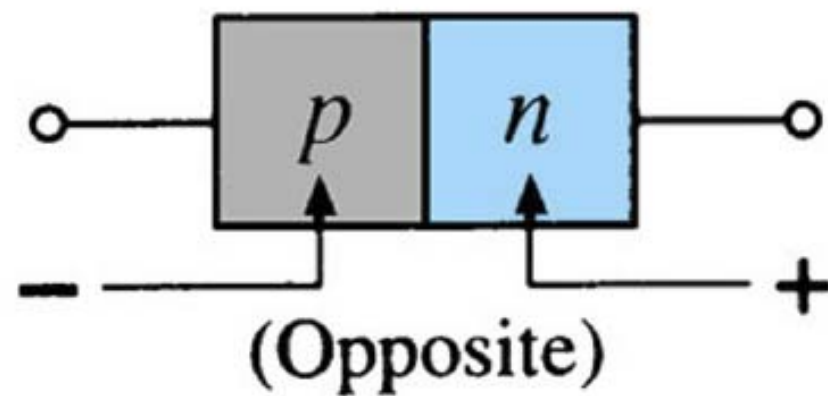
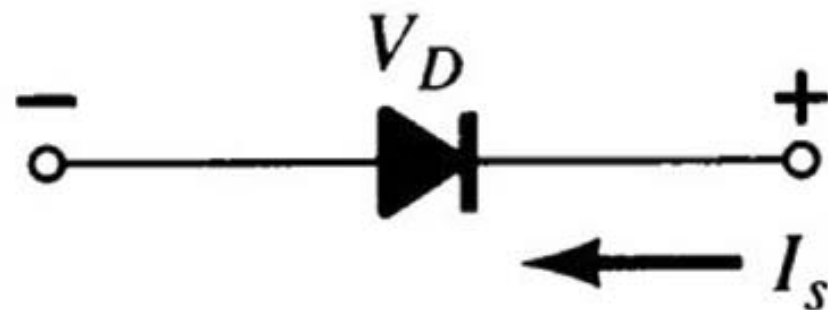
Junção PN – Sem polarização



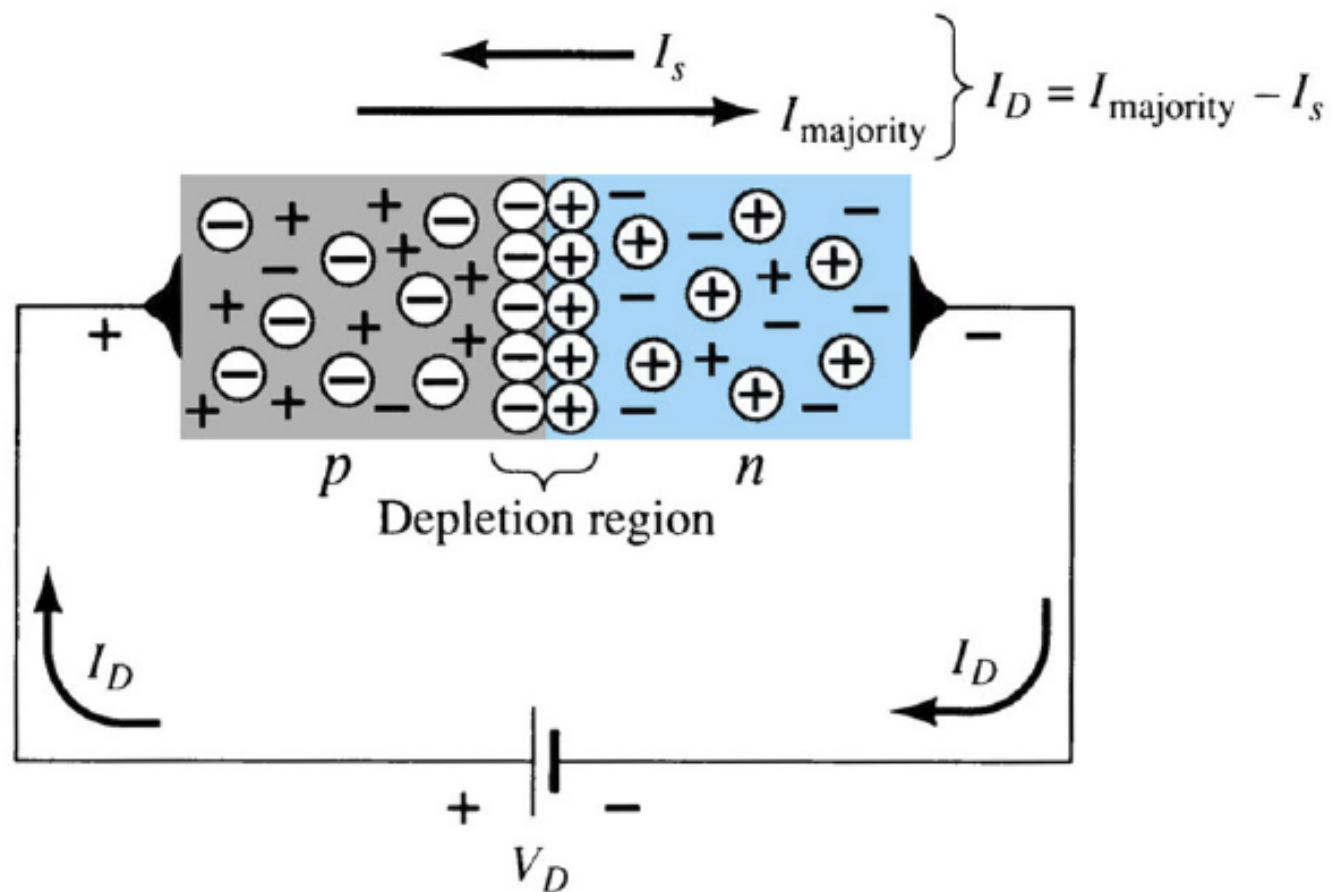
Junção PN – Reversamente polarizada



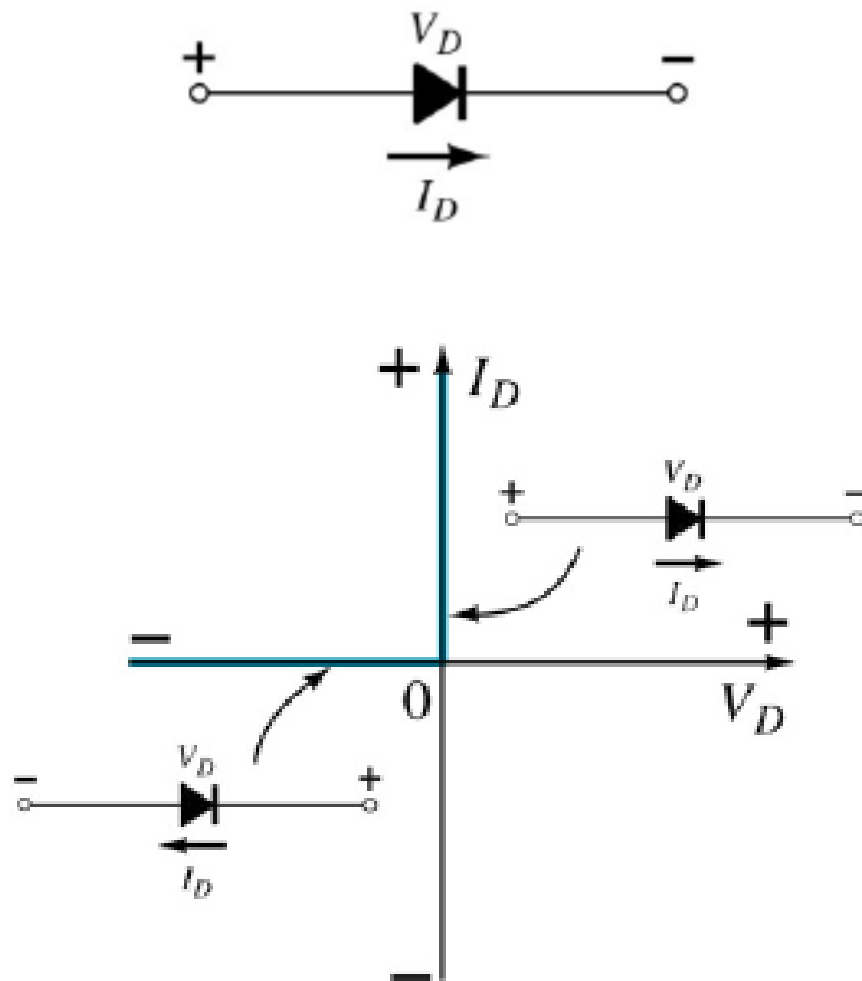
Junção PN – Reversamente polarizada



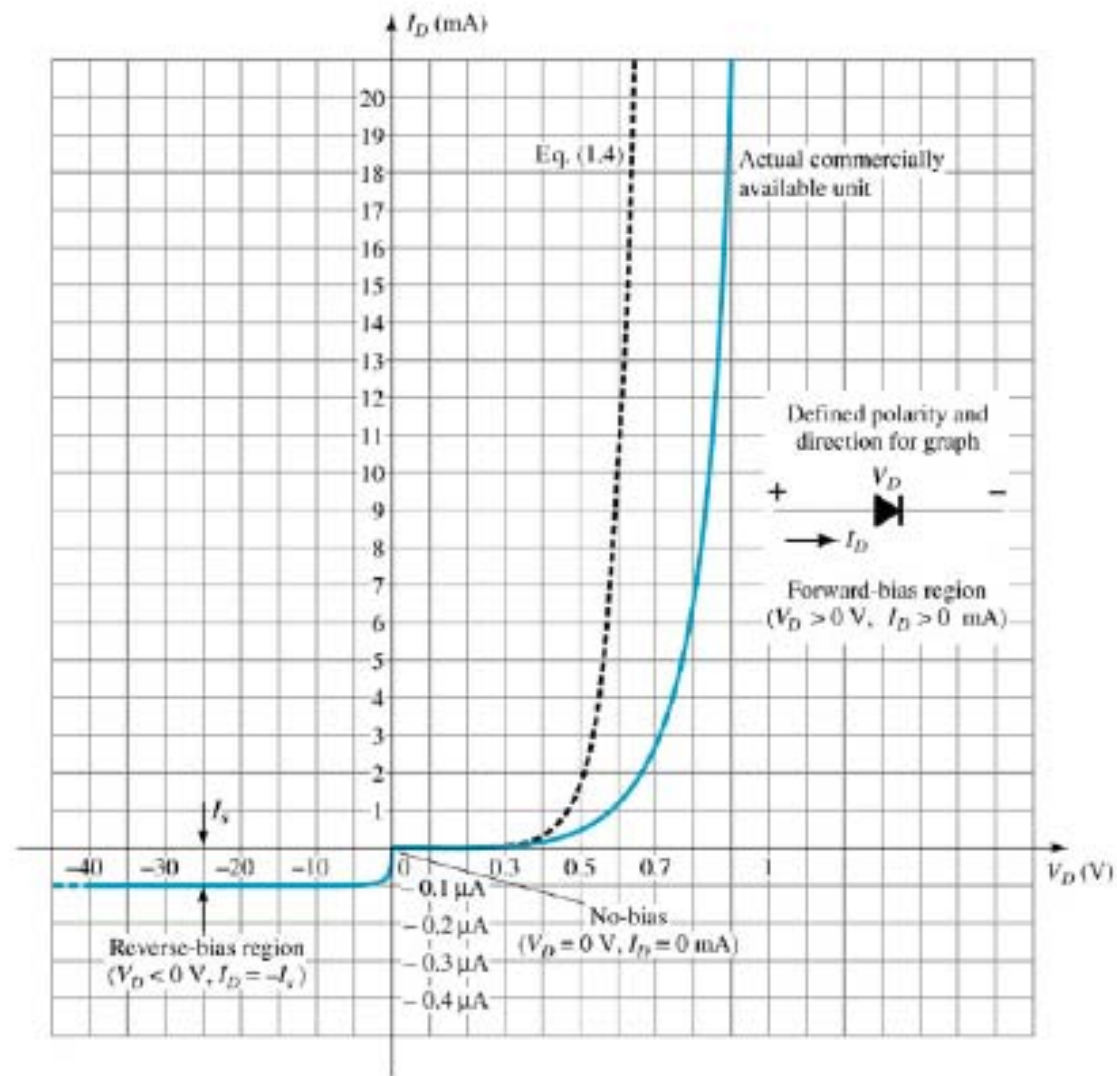
Junção PN – Diretamente polarizada



Diodo semicondutor – Símbolo e curvas



Diodo – Curva $I_D \times V_D$



Diodo – Curva $I_D \times V_D$

$$I_D = I_S \left(e^{\frac{K \cdot V_D}{T_K}} - 1 \right)$$

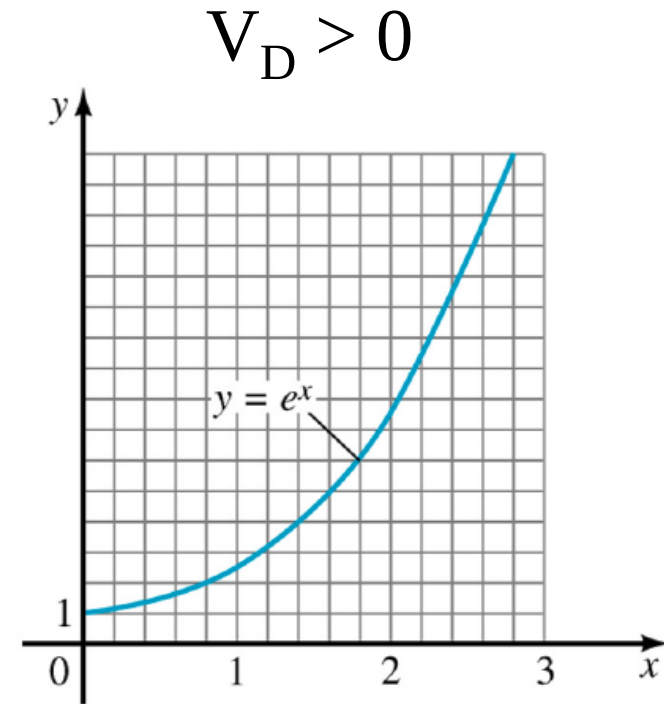
- I_D = corrente direta;
- V_D = tensão de polarização;
- I_S = corrente de saturação reversa;
- $K = 11.600/n$ com $n = 1$ para o Ge e $n = 2$ para o Si;
- $T_K = T_C + 273^\circ$.

Diodo – Curva $I_D \times V_D$

$$I_D = I_S \cdot e^{\frac{K \cdot V_D}{T_K}} - I_S$$

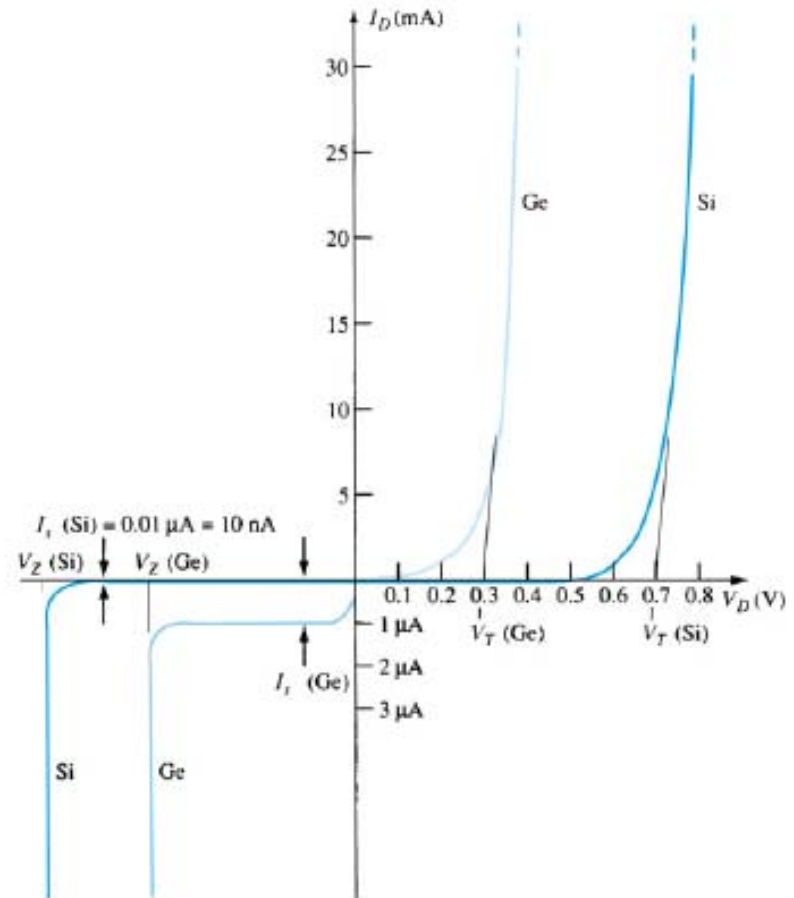
$$V_D = 0 \quad \longrightarrow \quad I_D = 0$$

$$V_D < 0 \quad \longrightarrow \quad I_D = I_S$$



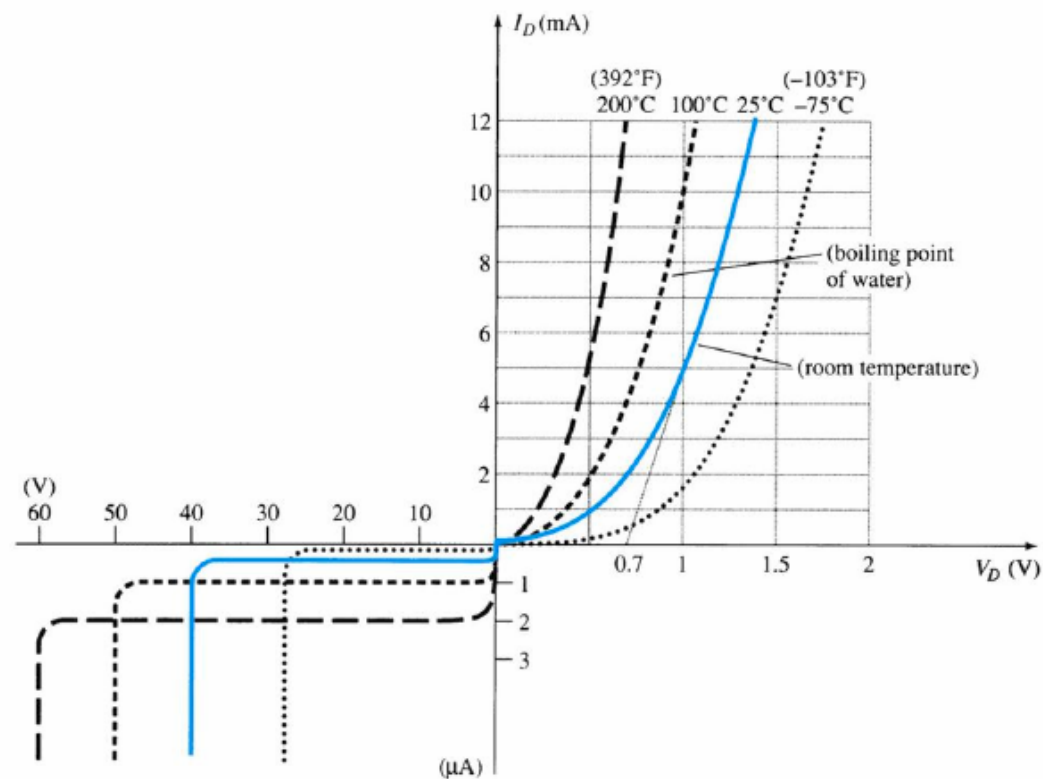
Silício versus Germânio

- 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.

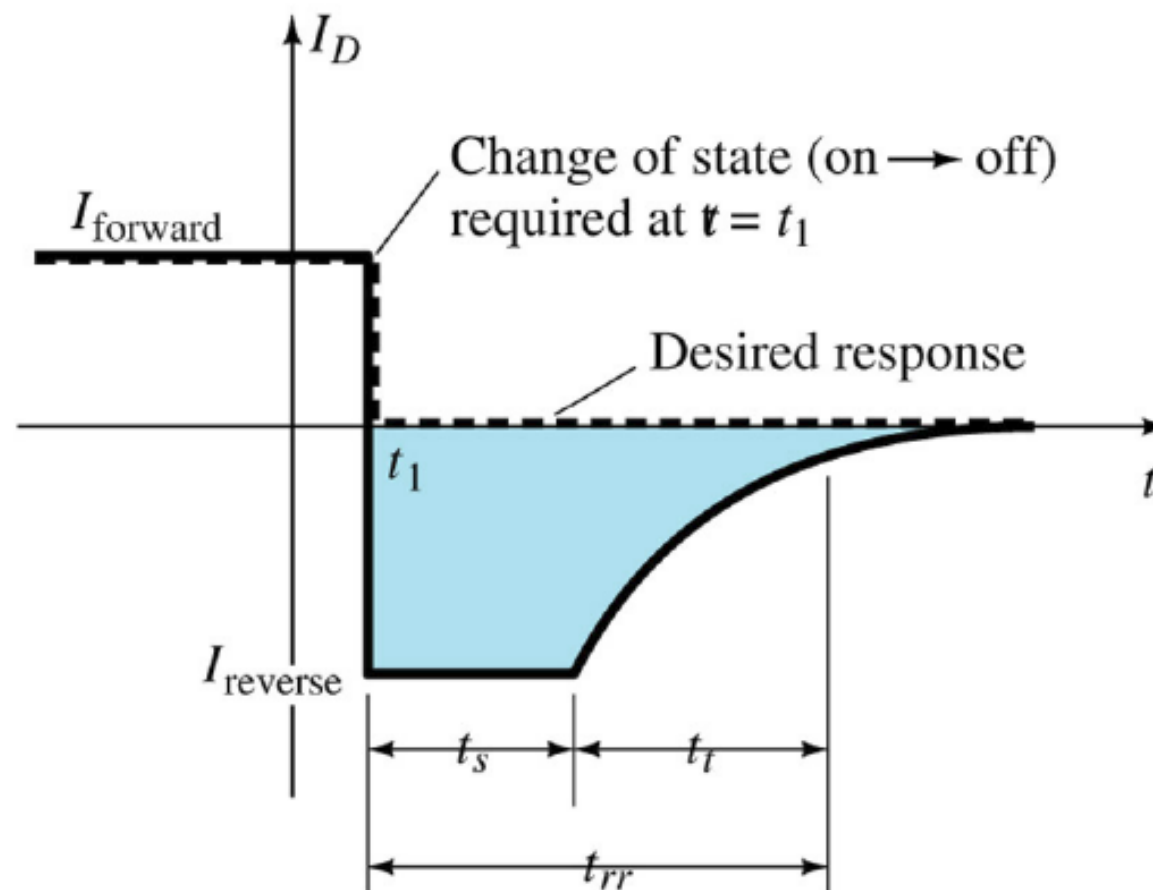


Efeitos da temperatura

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



Recuperação reversa



Recuperação reversa – Si x SiC

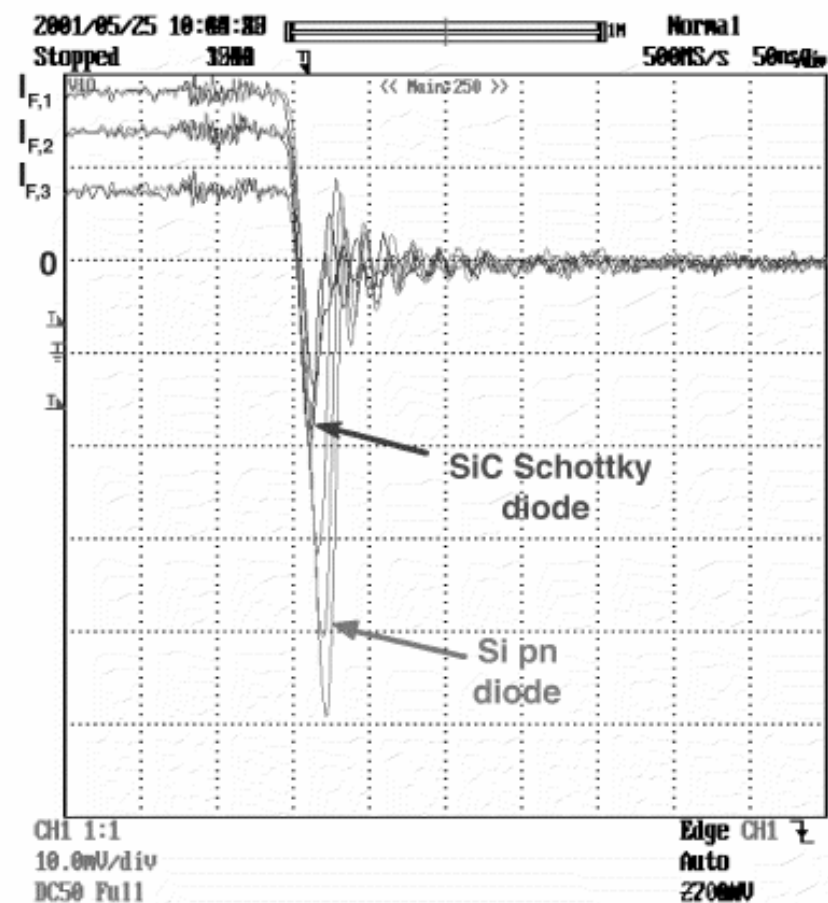


Fig. 5. Typical reverse recovery waveforms of the Si pn and SiC Schottky diode for three different forward currents (2 A/div.).

Recuperação reversa – Si x SiC

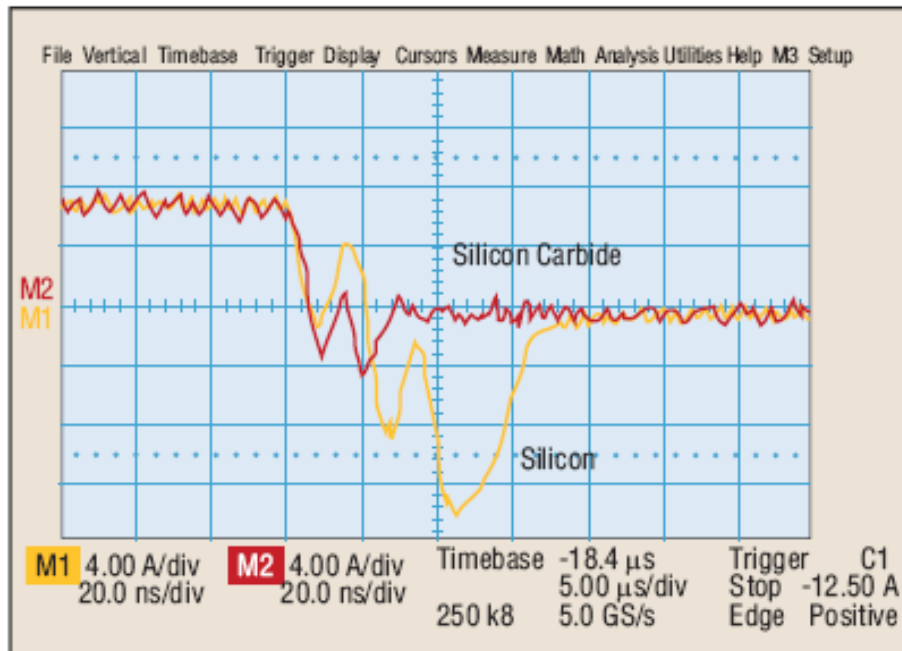


Fig.4. Low-line diode recovery currents in PFC front-end converter.

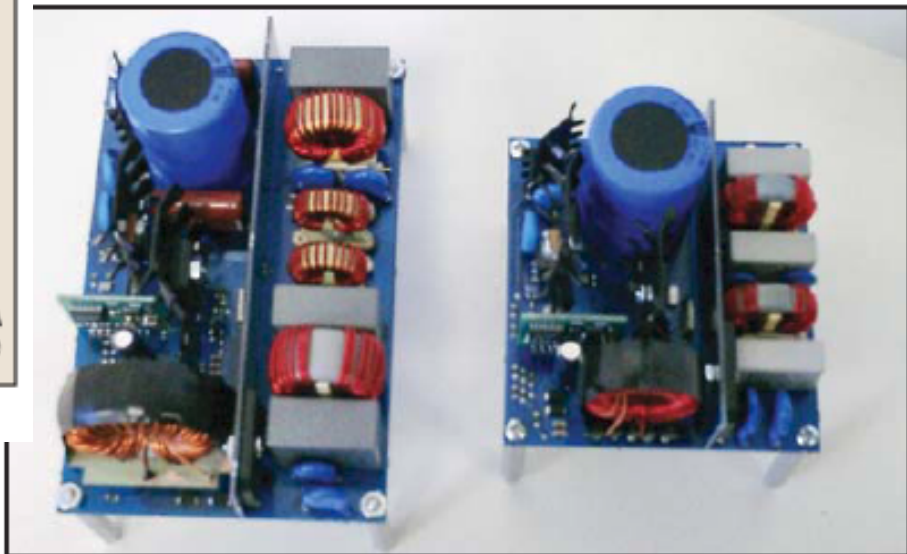
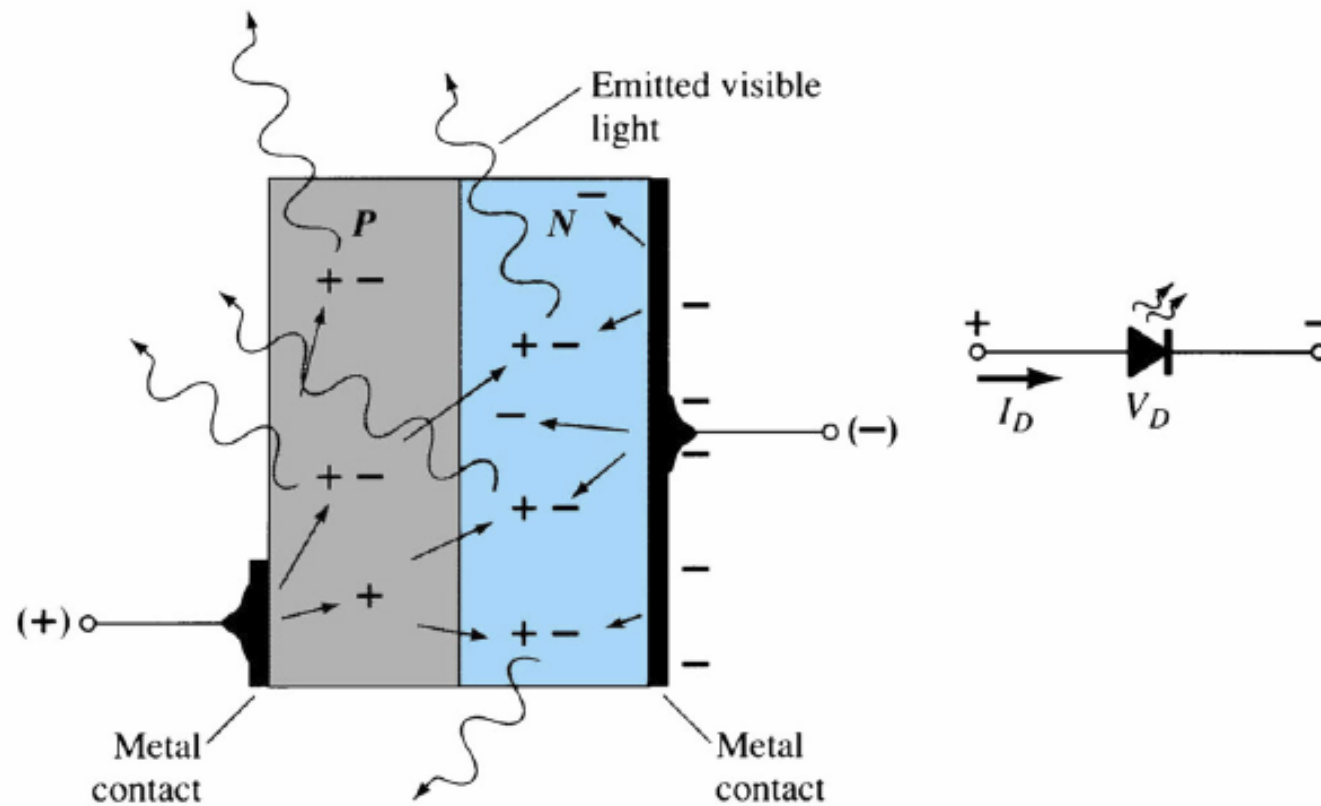
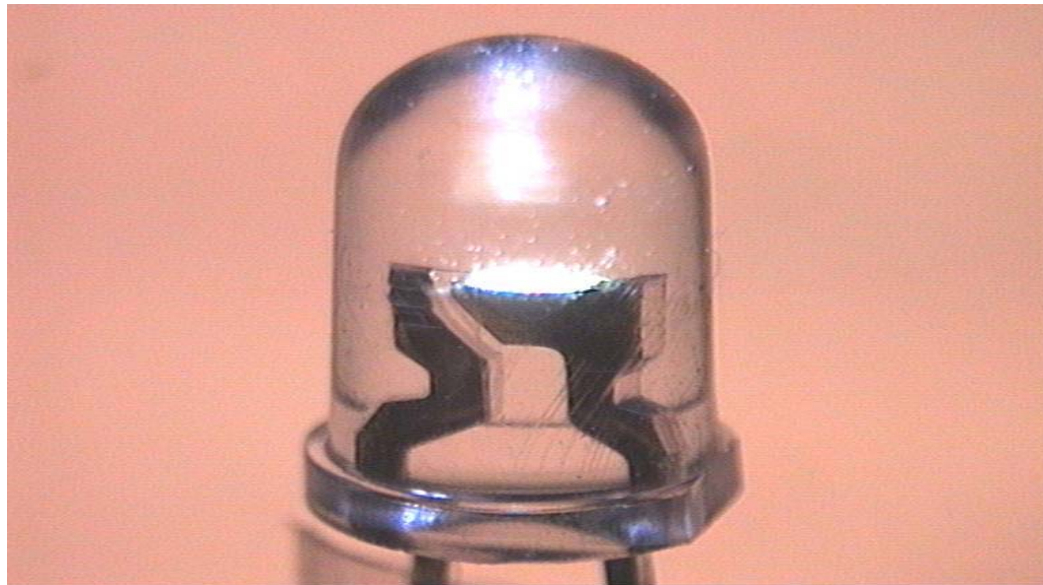
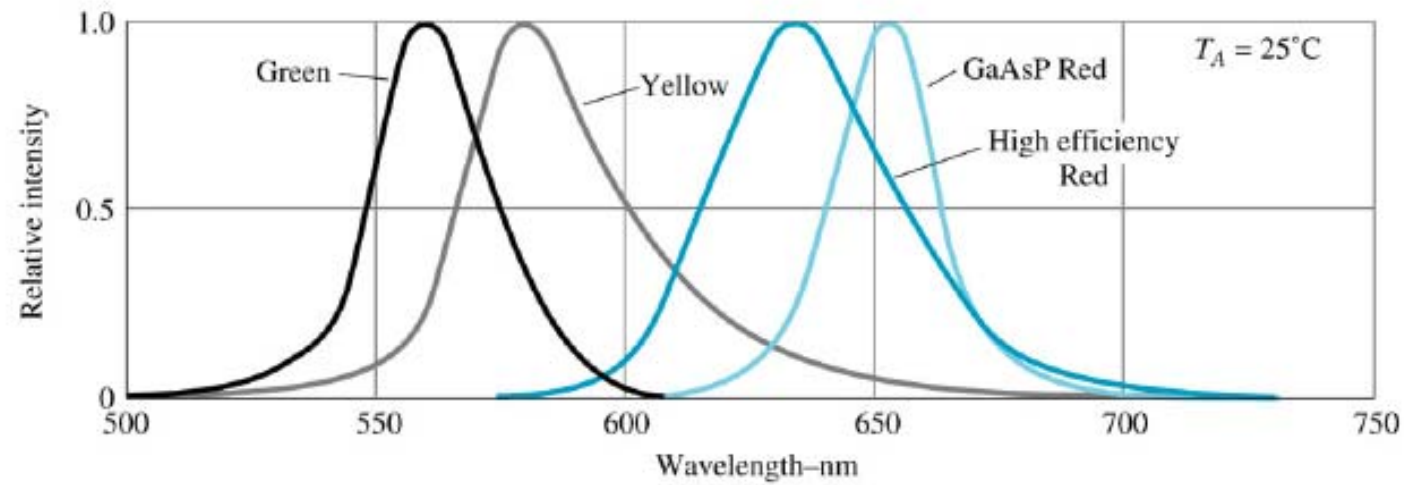


Fig.8. A size comparison of an 80-kHz PFC front-end built with Si rectifiers (left) and a 200-kHz PFC front-end with SiC rectifiers.

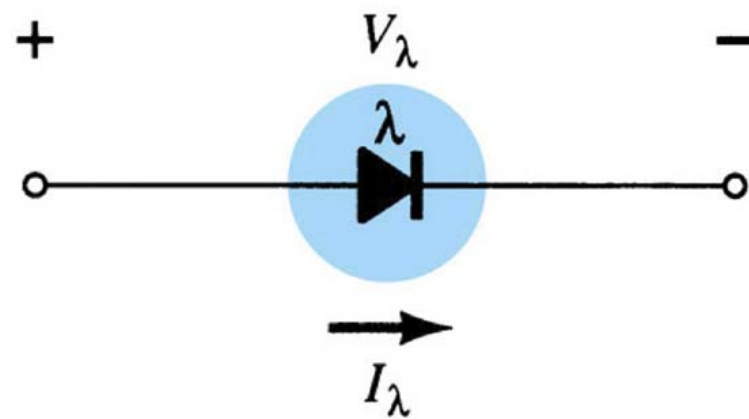
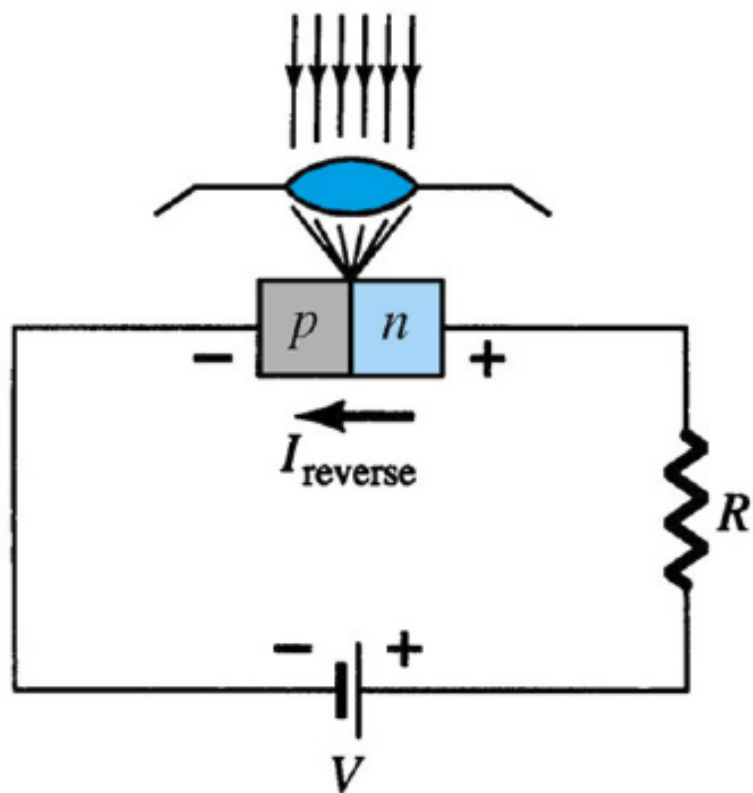
Diodos emissores de luz



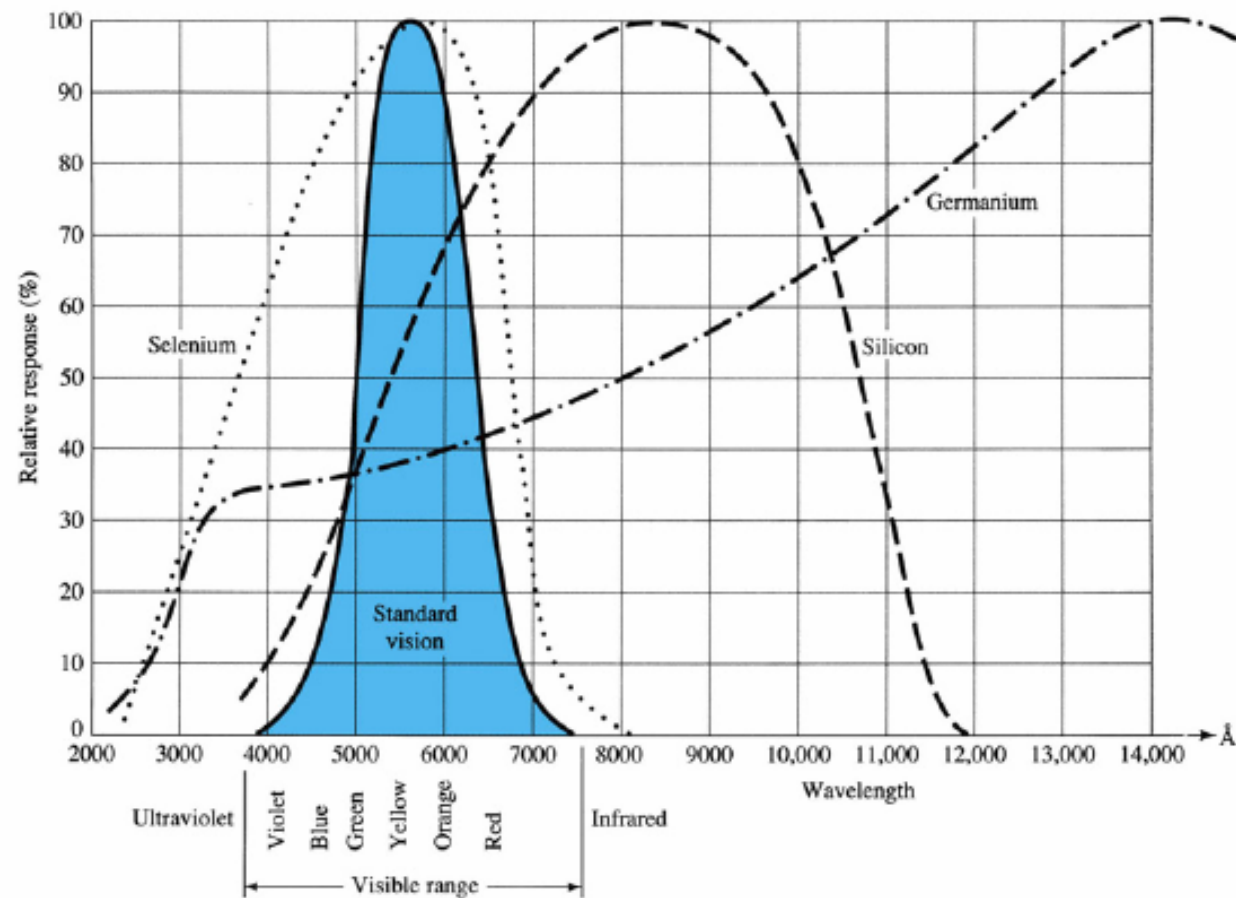
Diodos emissores de luz



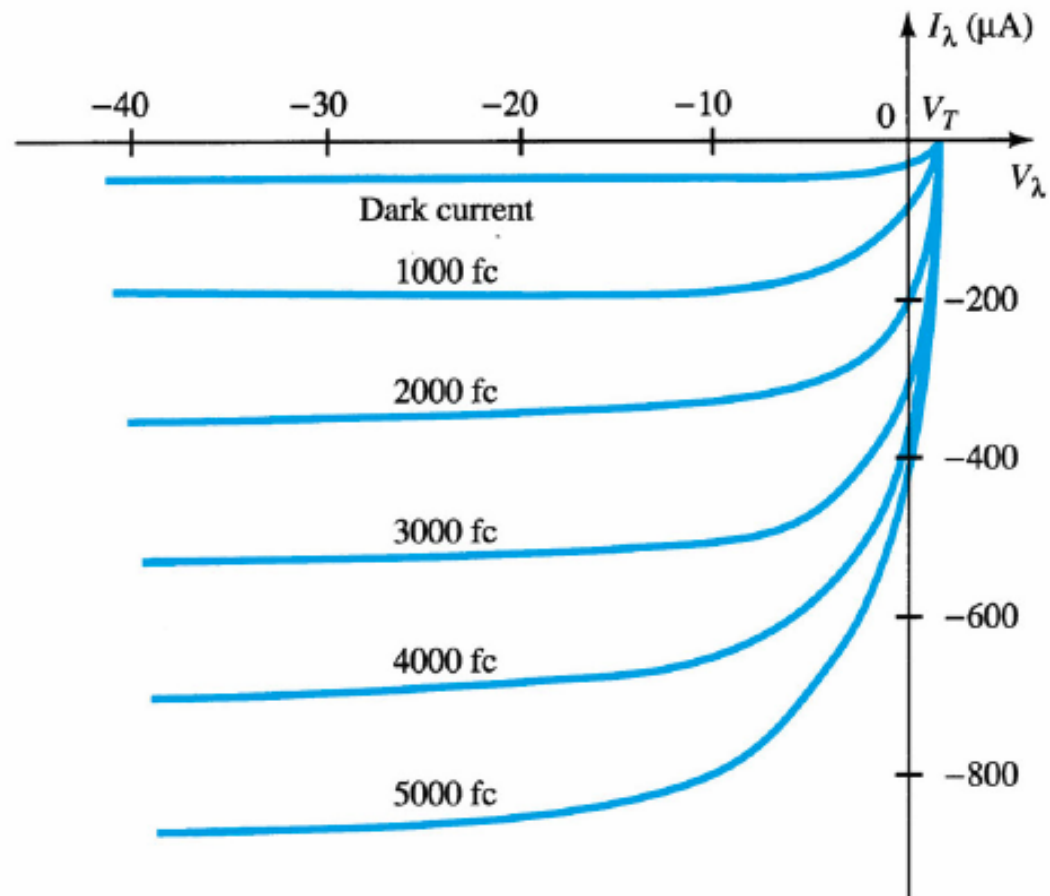
Fotodiodos



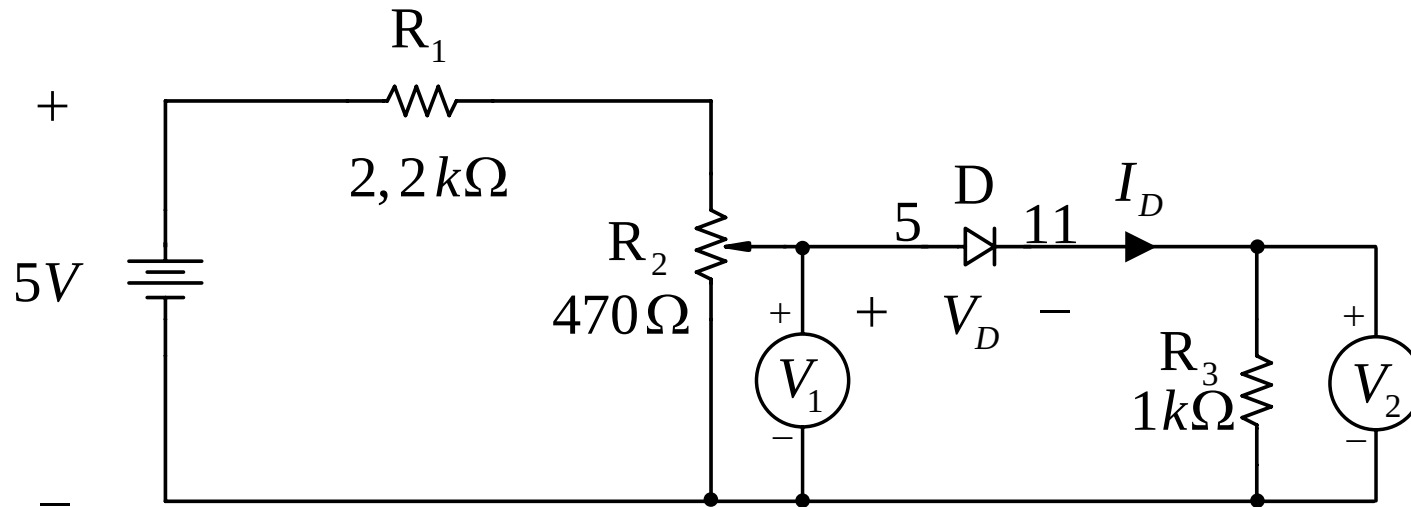
Fotodiodos



Fotodiodos

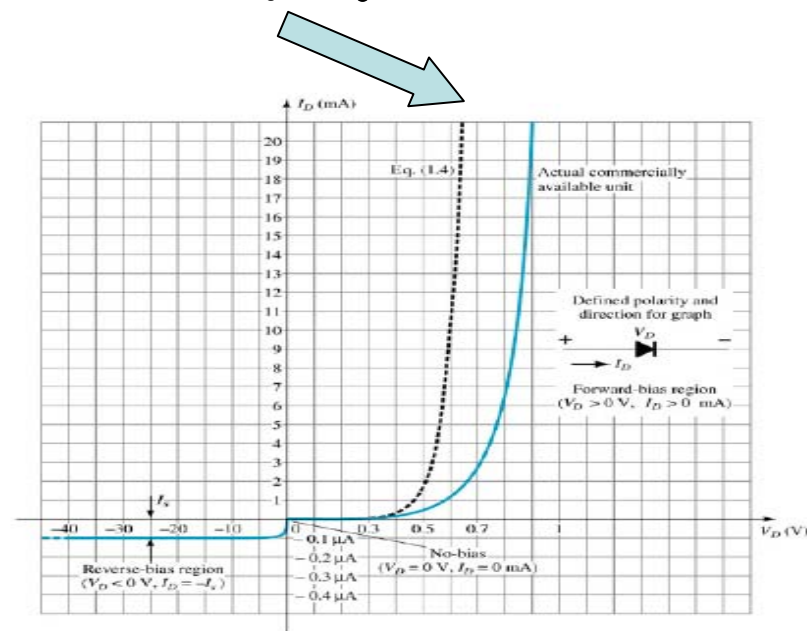


Parte experimental – Curva $V_D \times I_D$ do diodo

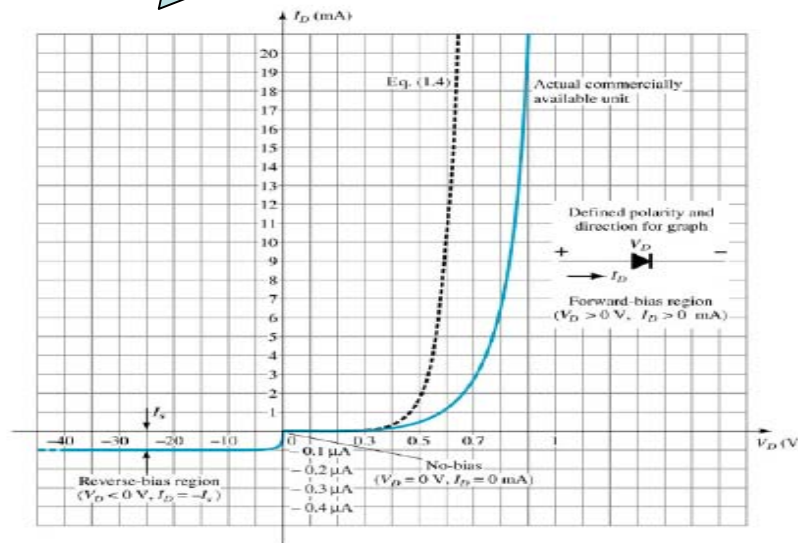
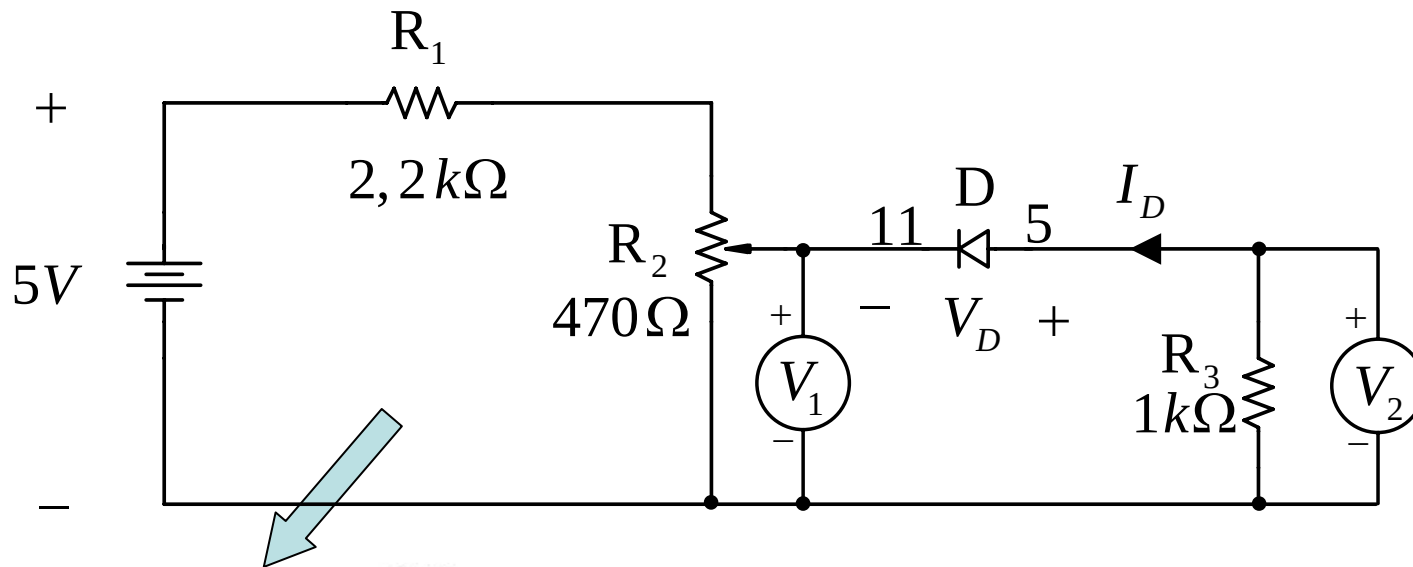


$$V_D = V_1 - V_2$$

$$I_D = \frac{V_2}{R_3}$$



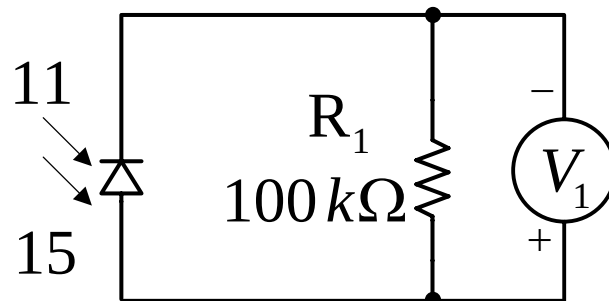
Parte experimental – Curva $V_D \times I_D$ do diodo



$$V_D = V_2 - V_1$$

$$I_D = -\frac{V_2}{R_3}$$

Parte experimental – Fotodiodos



Iluminação no fotodiodo	V_1
Escuro	
Ambiente	
Iluminado	

Iluminação no fotodiodo	Fotodiodo	V_1
Escuro	D ₁ (pinos 11 e 15)	
Ambiente		
Iluminado		
Escuro	D ₂ (pinos 11 e 16)	
Ambiente		
Iluminado		
Escuro	D ₃ (pinos 1 e 2)	
Ambiente		
Iluminado		
Escuro	D ₅ (pinos 11 e 14)	
Ambiente		
Iluminado		

Parte experimental – Circuito integrado nº 3

SCHOOLS CHIP PROJECT

Chip 03
p-n junction diodes
Photodiodes

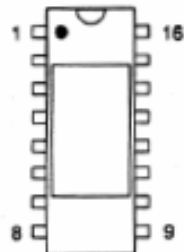
1

General description

The chip contains:

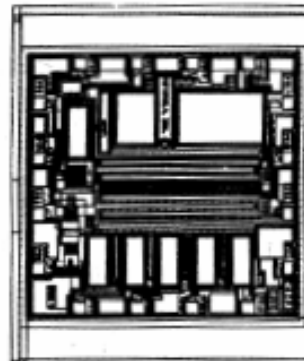
- 5 identical p+n photodiodes
- 2 larger area p+n photodiodes
- 2 edge p+n photodiodes
- 1 n+p-well photodiode
- 3 'black' diodes

Package



Ceramic dual-in-line
16 pins glass lid
0.3" wide 0.1" pin pitch
Max power rating 1 W

Chip plan view



MOTOROLA

Compugraphics International Ltd

University of Edinburgh

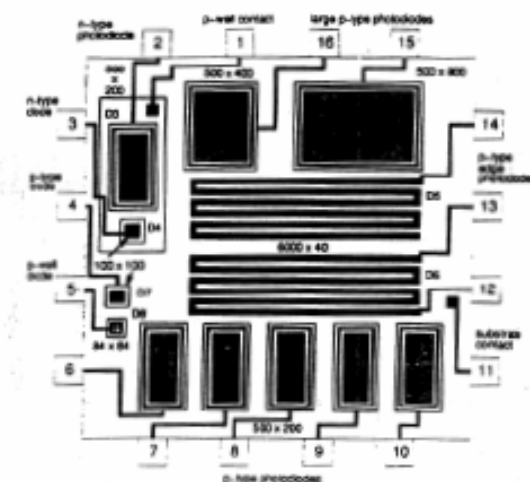
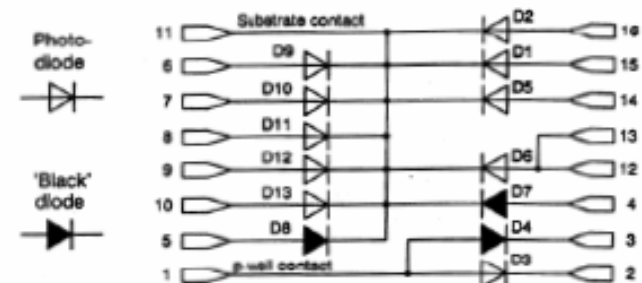
Scottish Enterprise

SCHOOLS CHIP PROJECT

Chip 03
p-n junction diodes
Photodiodes

2

Component layout



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