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

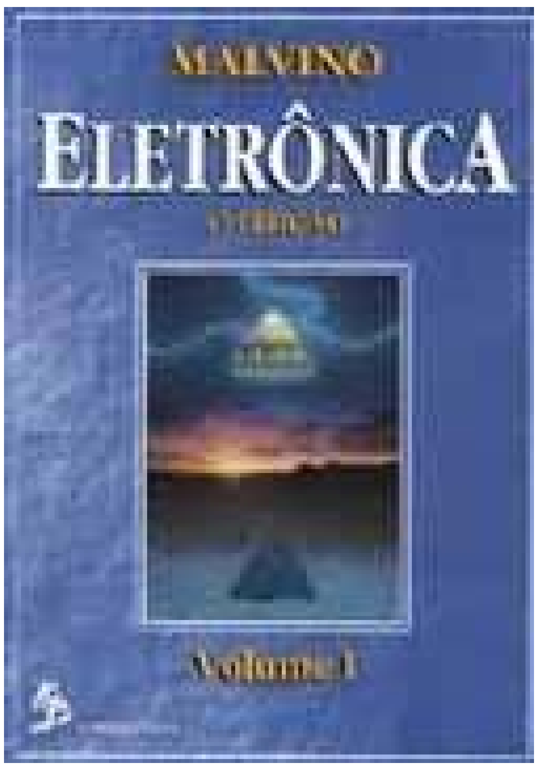
Diodos e dispositivos especiais
Parte 2

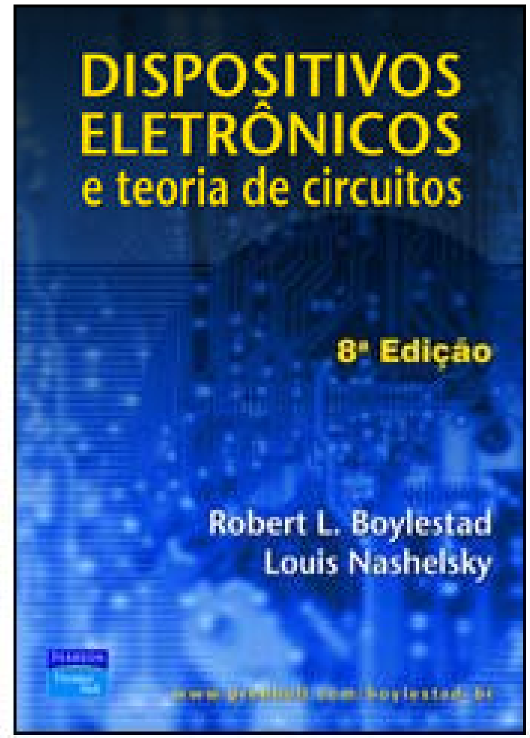
Prof. Clóvis Antônio Petry.

Florianópolis, maio de 2008.

Bibliografia para esta aula

1. Diodos e dispositivos especiais – Parte 2.





www.cefetsc.edu.br/~petry

Nesta aula

Seqüência de conteúdos:

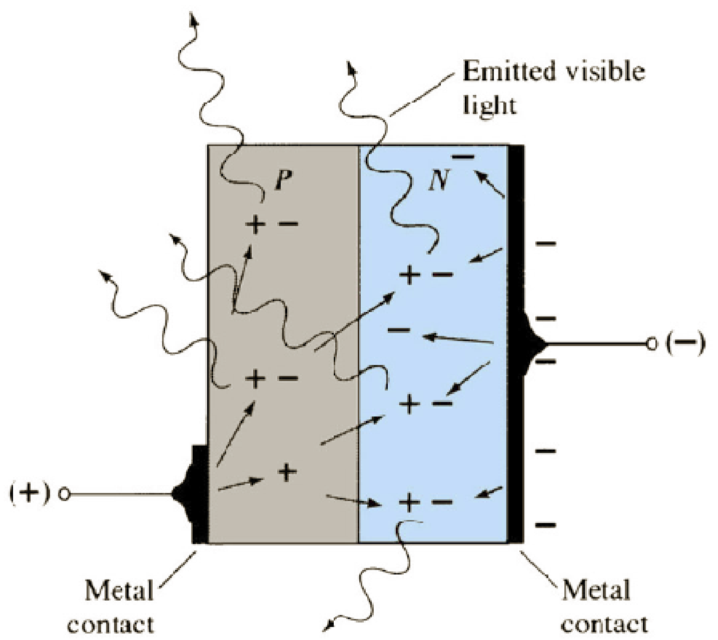
1. Parte C – Diodos:
   - LEDs;
   - Fotodiodos;
2. Parte D – Transistores:
   - Fototransistores;
   - Optoacopladores;
3. Parte E – Outros dispositivos:
   - Células solares.
4. Parte F – Semicondutores de Carbeto de Silício (Silicon Carbide).

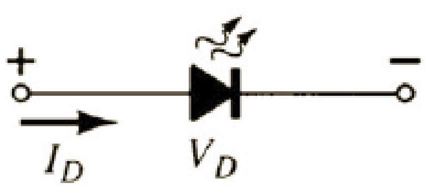
Diodos

LEDs

Diodos emissores de luz (LEDs):

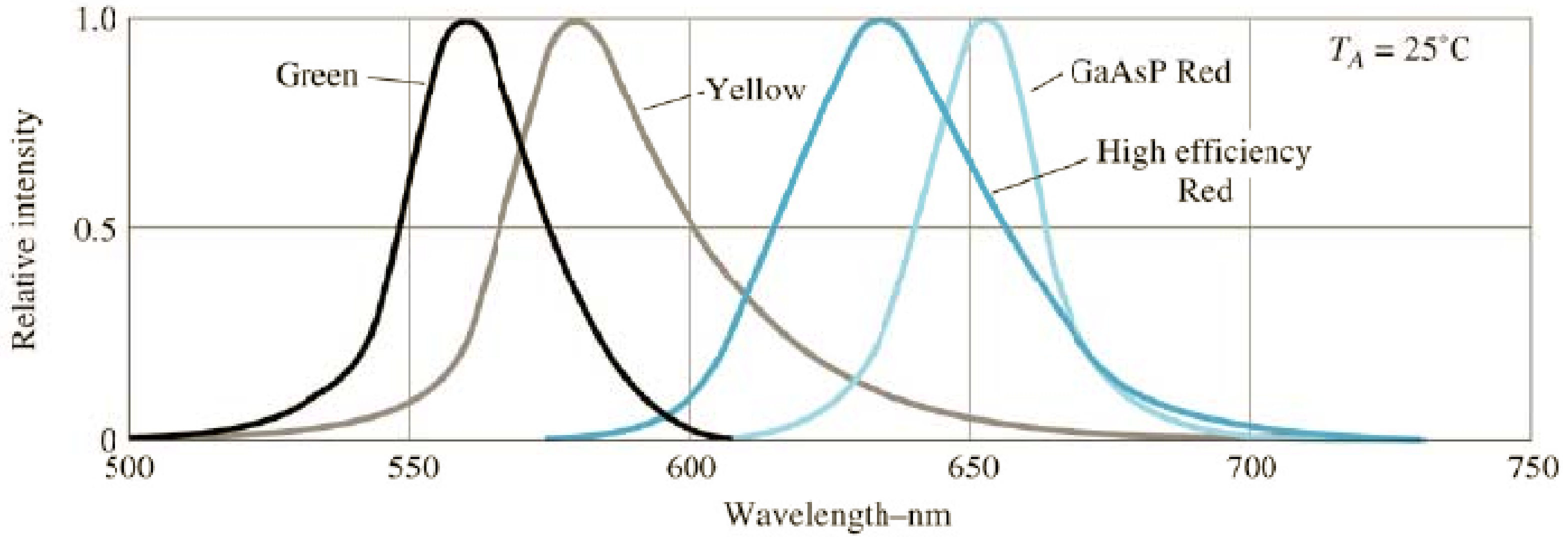
- Eletroluminescência – processo de emissão de luz pela aplicação de uma fonte elétrica de energia.





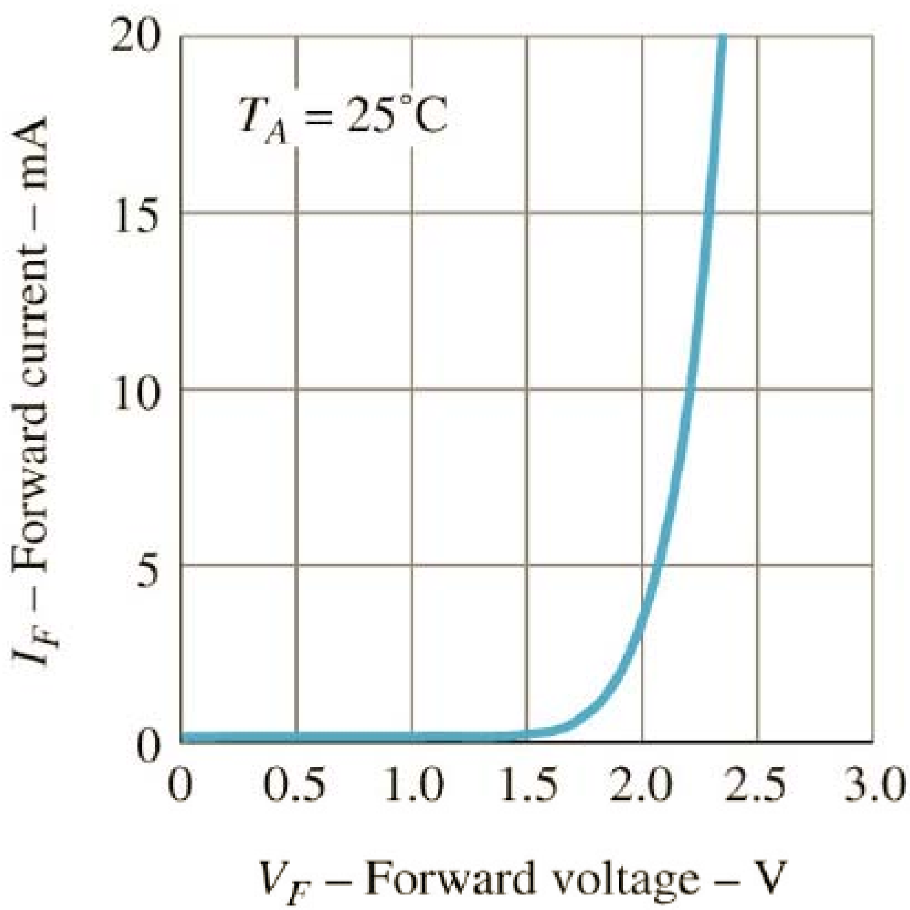
LEDs

Comprimentos de onda dos leds:



LEDs

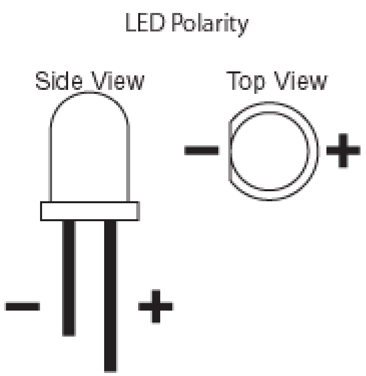
Corrente direta versus tensão direta para leds miniatura:

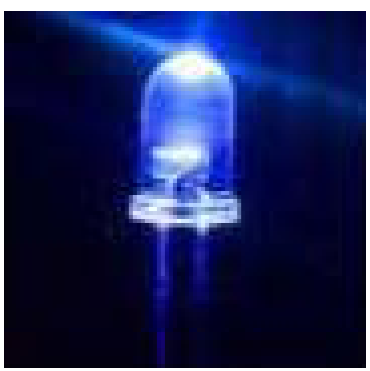


LEDs

Exercícios:

- Dimensionar circuitos com LED conforme especificações de fabricantes.



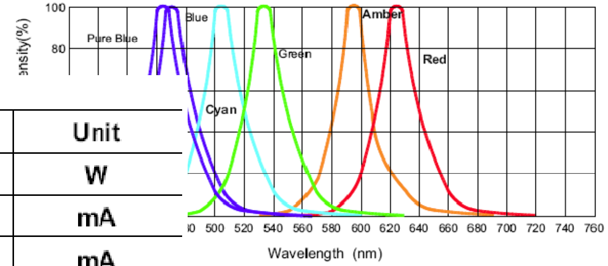


Spec	Value
Product ID	L4-0-Y5TH30-1
Angle	30
Package	5mm
Color	
Peak Wavelength in nm	590
Luminous Intensity	5000mcd typ. @ 20mA
Max Forward Current	30mA
Max Forward Current Pulse	100mA for <= 10ms, duty <= 1/10
Forward Voltage	2.25V typ. 2.6V max @ 20mA
Max Reverse Voltage	5V
Power Dissipation	
Operating Temp	-30 to +85 C
Soldering Temp	260 C for 5 Sec.
Max Reverse Current	10uA @ 5V

http://www.ledsupply.com

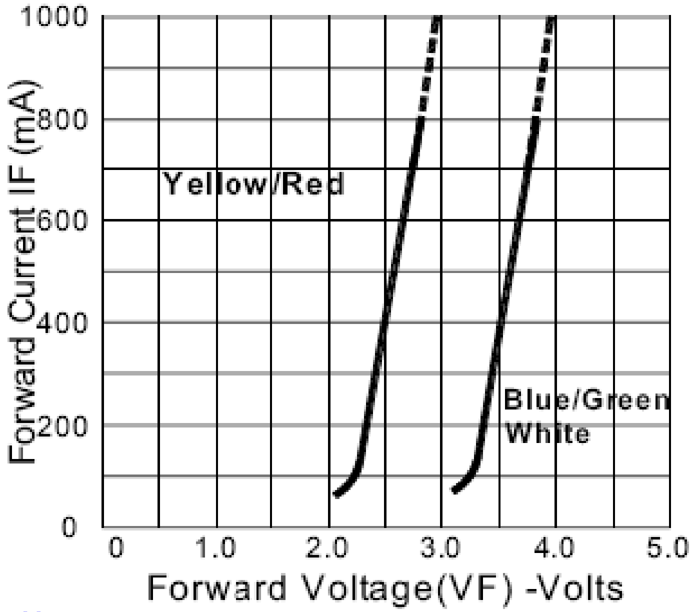
LEDs

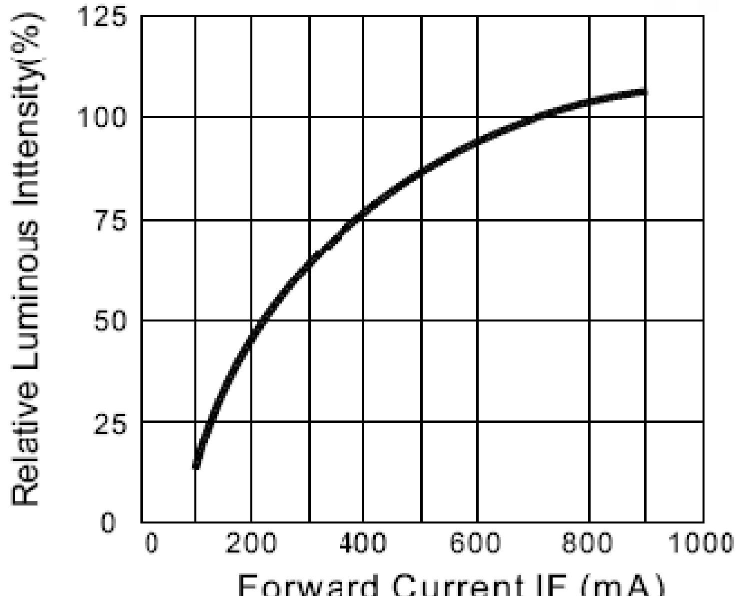
SPECIFICATIONS FOR UPEC POWER LIGHT SOURCE TYPE LED



Absolute Maximum Ratings at Ta=25℃

Parameter	Symbol	Max	Unit
Power Dissipation	PD	3	W
Pulse Forward Current	IPF	1000	mA
Forward Current	IF	700	mA
Reverse Voltage	VR	5	V
Operating Temperature Range	Topr	- 40 to +85	℃
Storage Temperature Range	Tstg	- 40 to + 85	℃





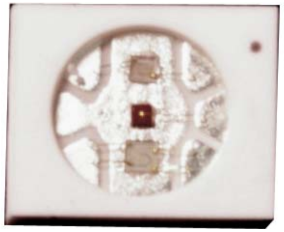
http://www.u-pec.com

LEDs

SPECIFICATIONS FOR UPEC LTCC LIGHT SOURCE LED

MAXIMUM RATINGS

Parameter	Symbol	Values			Unit
		Red	Pure Green	Blue	
Operating temperature range	T_{op}	-40 … + 85			℃
Storage temperature range	T_{stg}	-40 … +100			℃
Power dissipation (Max)	P_d	2			W
Pulse forward current per chip	I_{pf}	250	300	250	mA
Forward current (R,G,B)	I_f	150	200	150	mA
Test current (White mixed)	I_f	100	200	50	mA
Reverse voltage	V_r	5			V



CHARACTERISTICS (T_J = 25 ℃)

Parameter	Symbol	Values			Unit
		Red	Pure Green	Blue	
Dominant wavelength	λ_{dom}	620~630	520~530	455~465	nm
Spectral bandwidth at 50 % (Typ)	$\Delta\lambda$	20	30	20	nm
Viewing angle at 50% Iv	$2\theta_{1/2}$	120	120	120	deg.
Forward voltage	V_f	2.0 3.0	2.8 3.6	2.8 3.6	V
Reverse current	I_r	100			μA

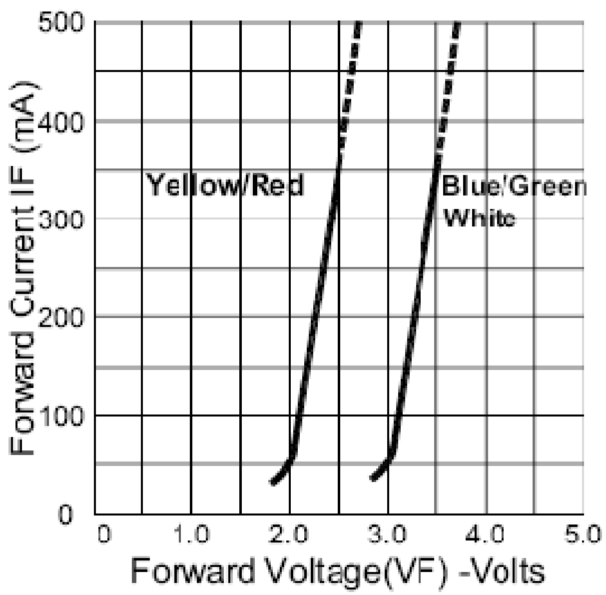
http://www.u-pec.com

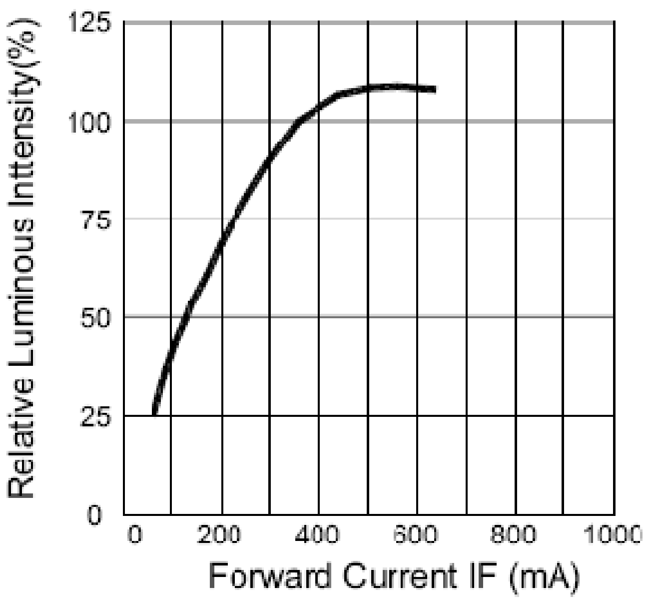
LEDs

SPECIFICATIONS FOR UPEC LED LIGHT SOURCE TYPE SYSTEM

Absolute Maximum Ratings at Ta=25℃

Parameter	Symbol	Max	Unit
Power Dissipation	PD	6	W
Pulse Forward Current	IPF	500	mA
Forward Current	IF	350	mA
Operating Temperature Range	Topr	- 40 to + 120	℃
Storage Temperature Range	Tstg	- 40 to + 120	℃



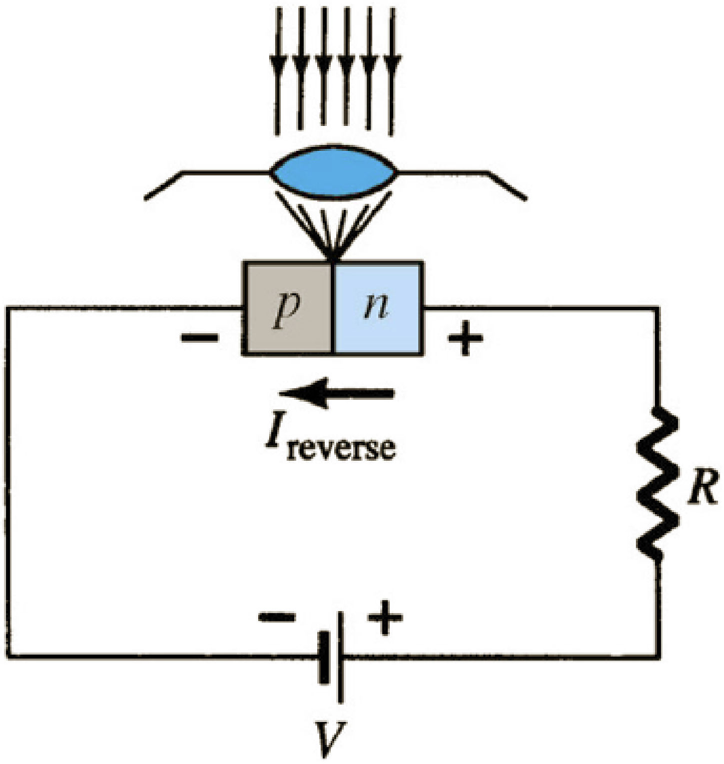


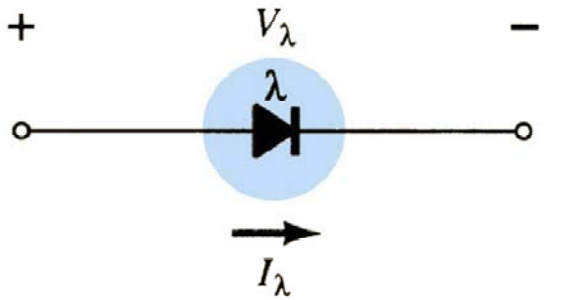
http://www.u-pec.com

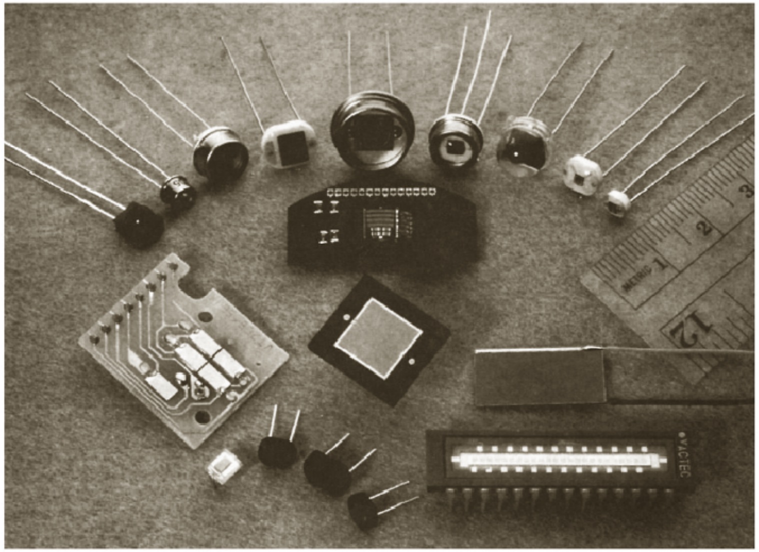
Fotodiodos

Fotodiodos:

- São diodos que operam na região reversa e são sensíveis à luz.
- Optoeletrônica – campo de estudo dos dispositivos sensíveis à luz.

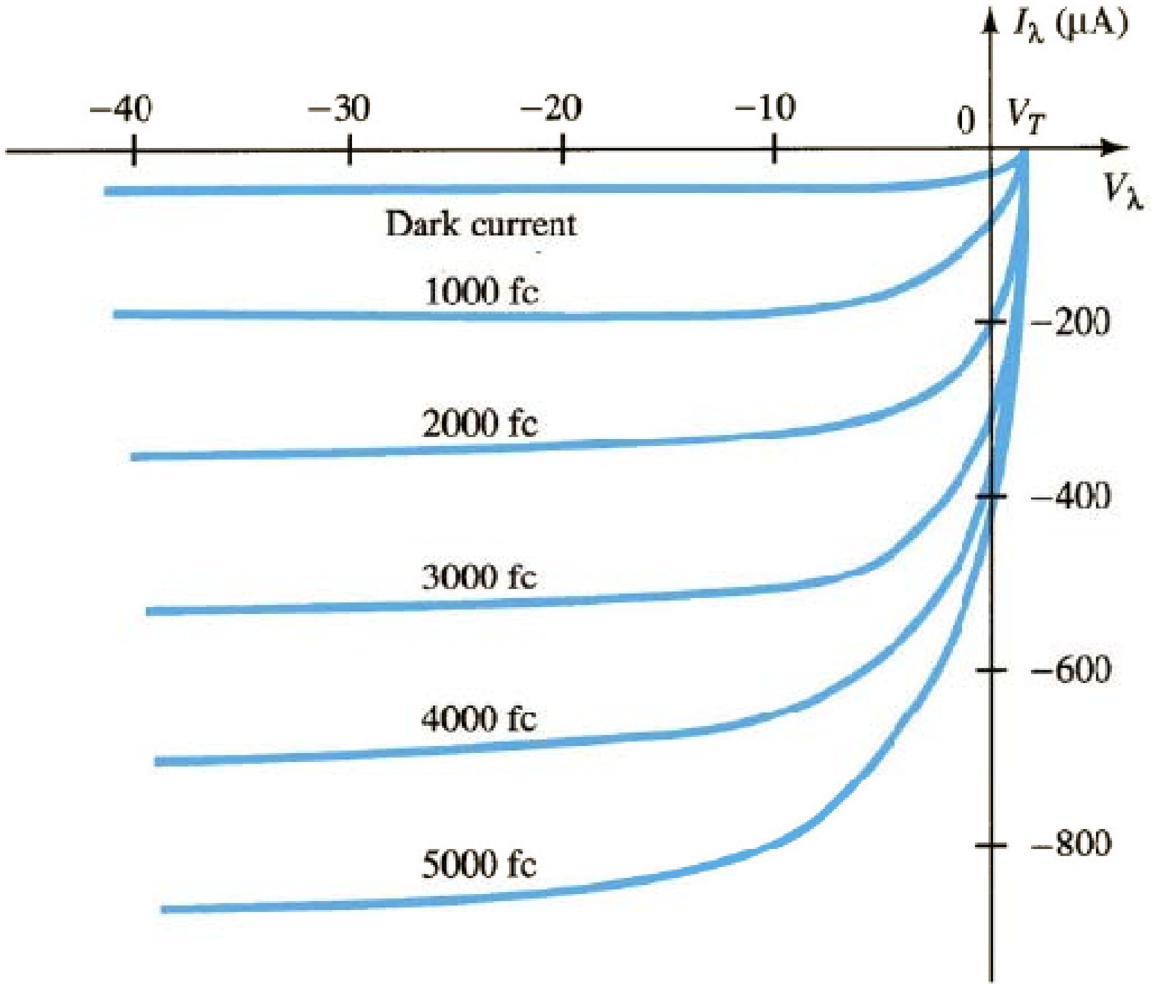






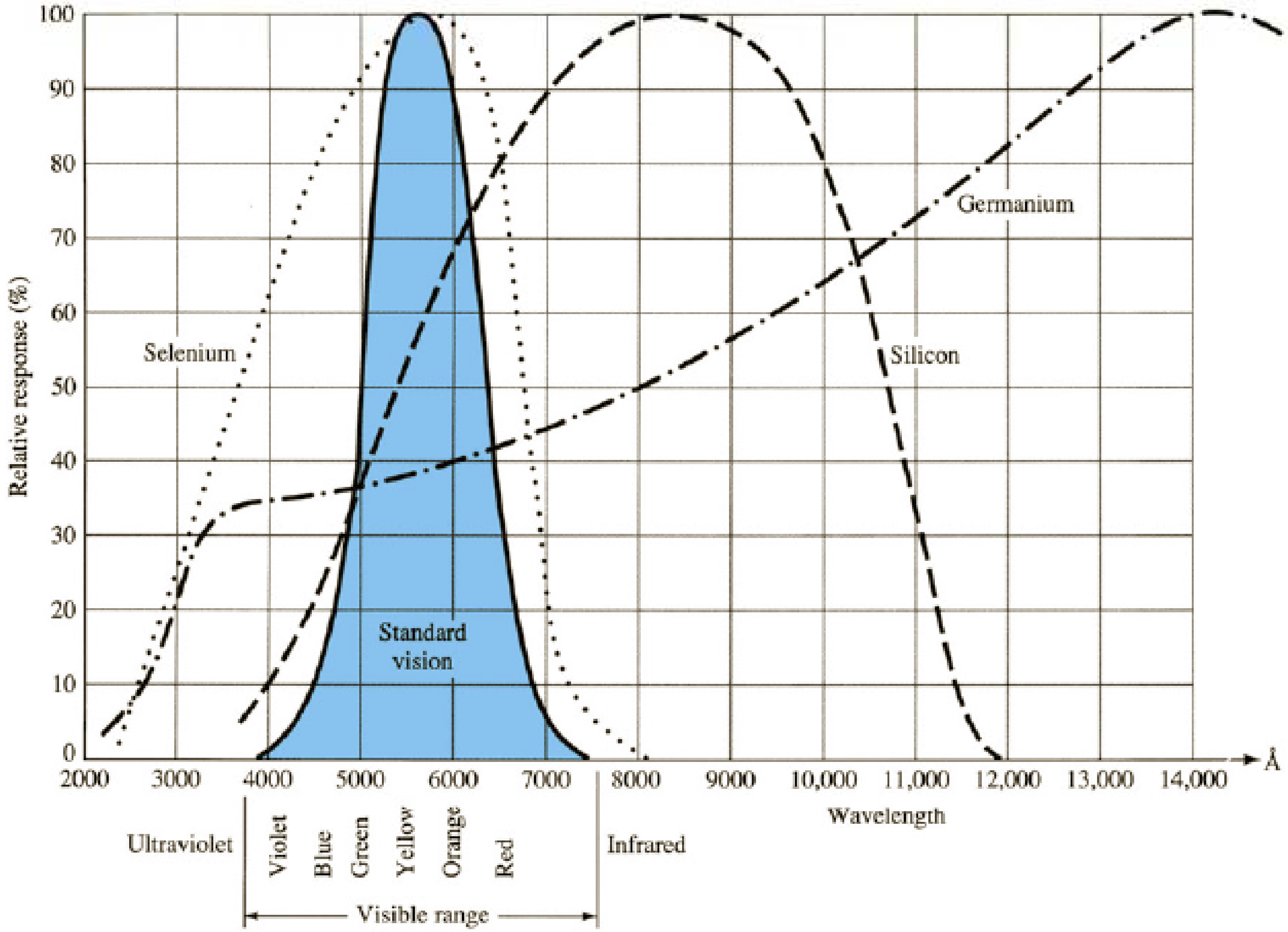
Fotodiodos

Curvas características dos fotodiodos:



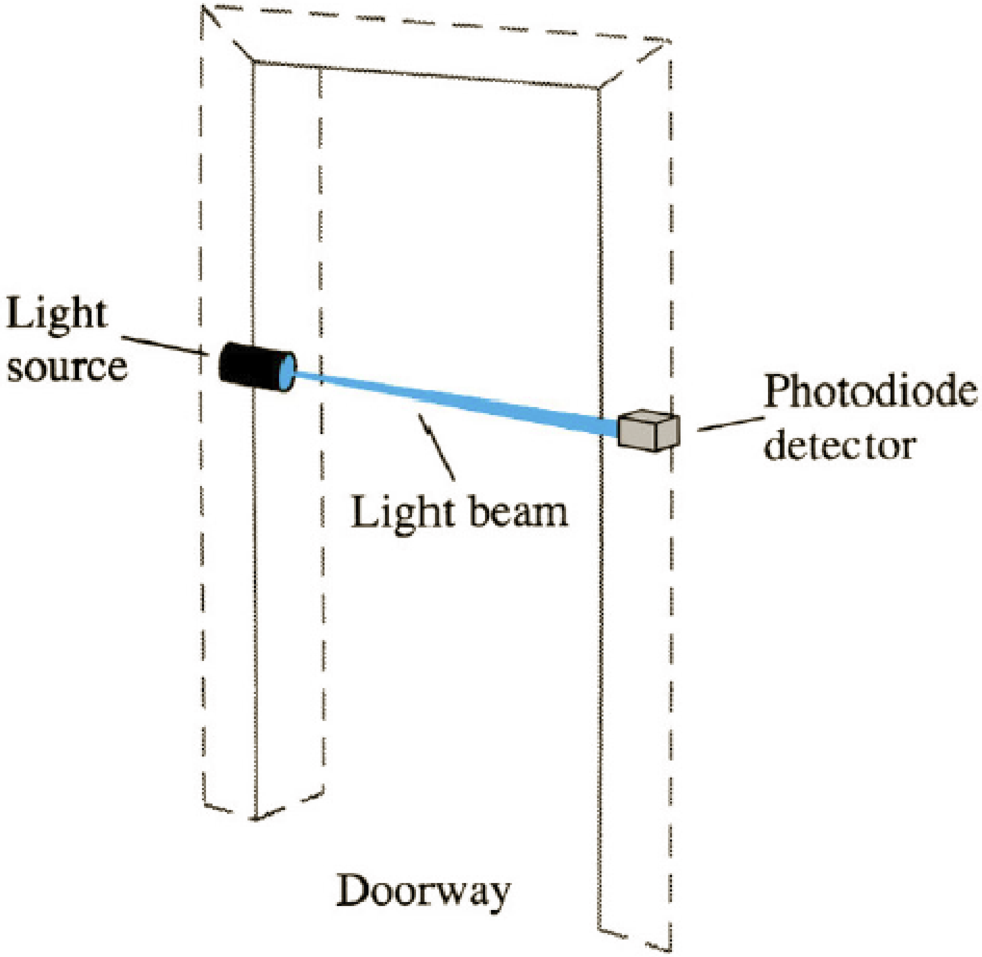
Fotodiodos

Resposta espectral de fotodiodos:



Fotodiodos

Exemplo de aplicação:



Transistores

Fototransistor

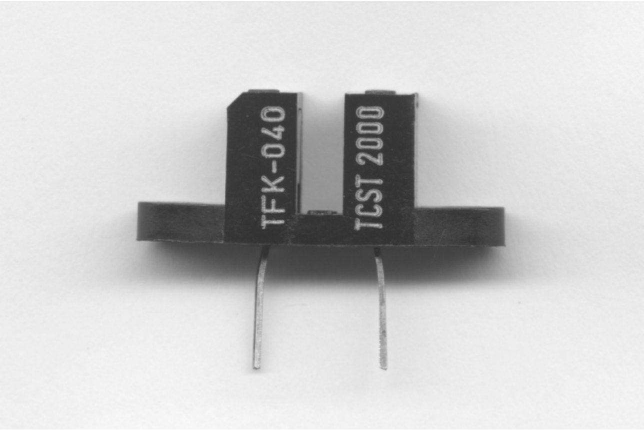
Fototransistor:

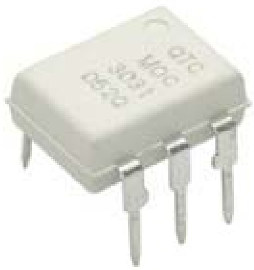
- São transistores sensíveis à luz.

Optoacopladores

Optoacoplador:

- São dispositivos que possuem no mesmo encapsulamento um fotodiodo e um fototransistor (ou tiristor), montados de maneira a permitirem o acoplamento óptico entre os dois.
- Usados para isolação entre circuitos, pois não ocorre ligação elétrica entre os circuitos, por exemplo para transmissão de dados.



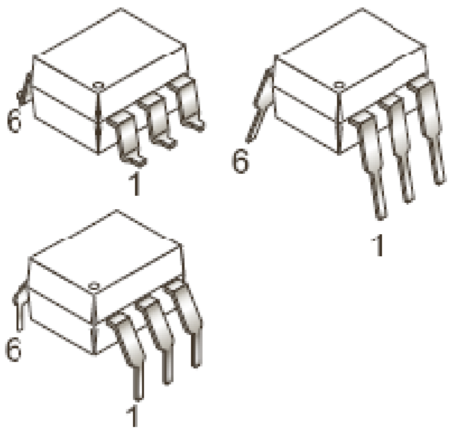


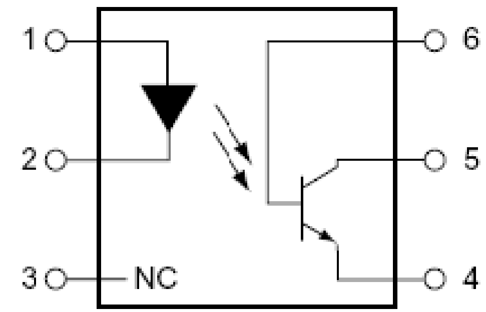
Optoacopladores

FAIRCHILD SEMICONDUCTOR

March 2007

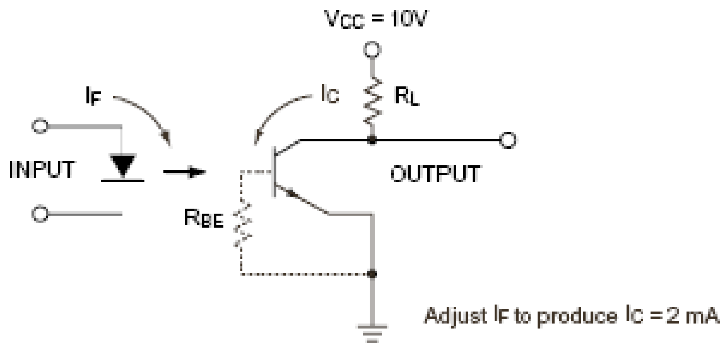
4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M, H11A1M, H11A2M, H11A3M, H11A4M, H11A5M
General Purpose 6-Pin Phototransistor Optocouplers



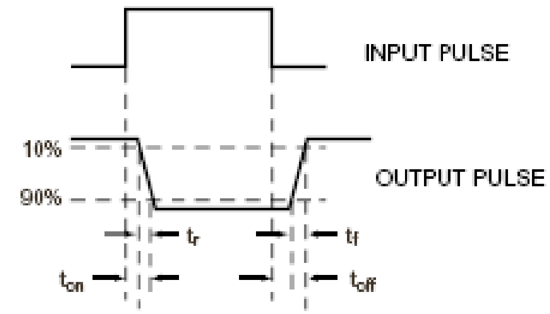


PIN 1. ANODE
2. CATHODE
3. NO CONNECTION
4. EMITTER
5. COLLECTOR
6. BASE

TEST CIRCUIT

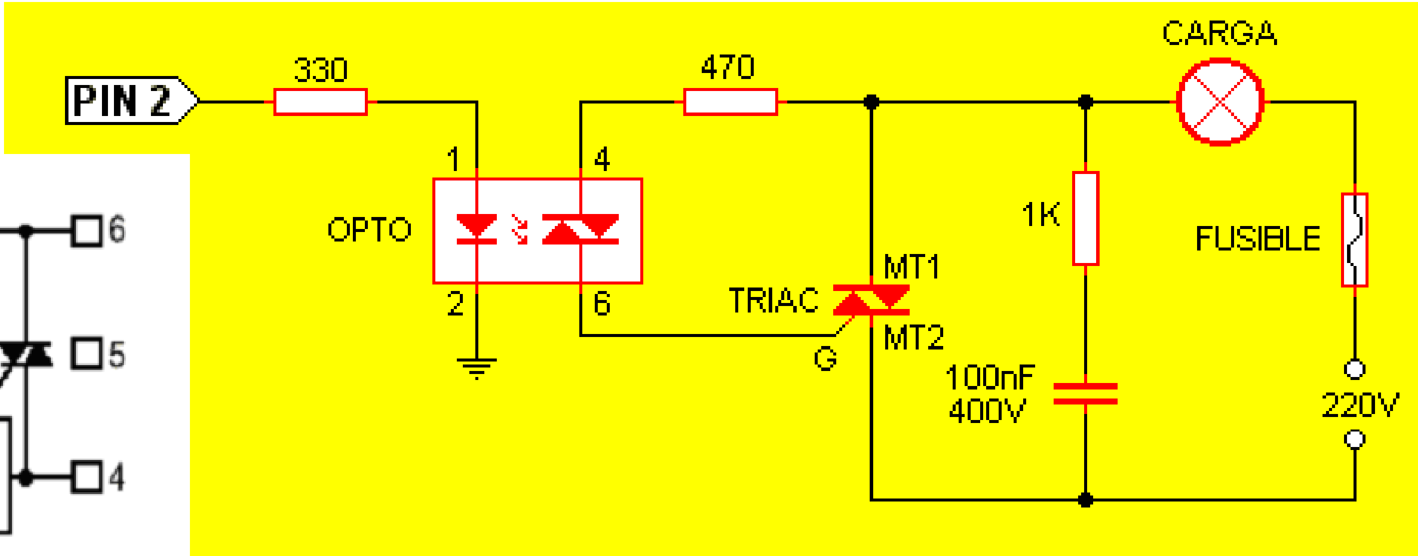


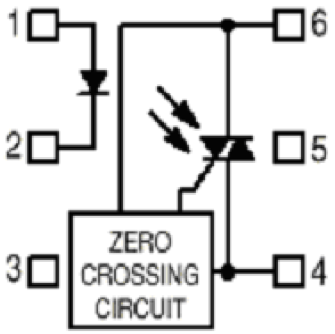
WAVE FORMS



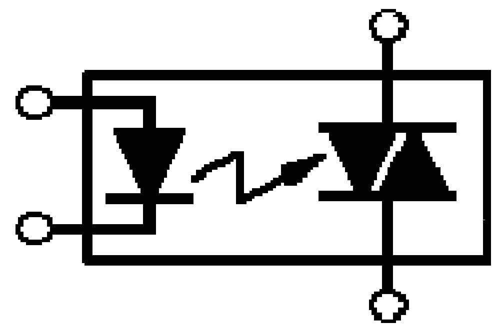
Optoacopladores

Optoacoplador com saída tiristorizada:





1. ANODE
2. CATHODE
3. NC
4. MAIN TERMINAL
5. SUBSTRATE
   DO NOT CONNECT
6. MAIN TERMINAL

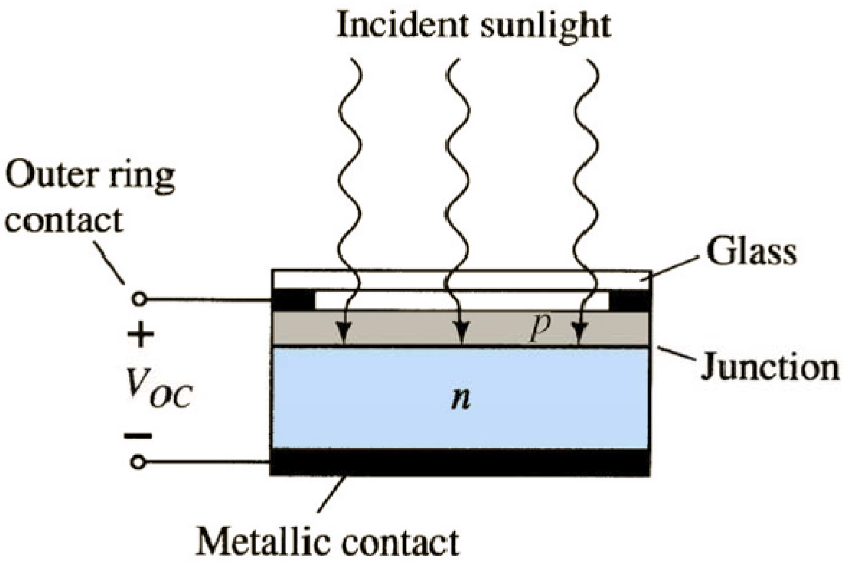


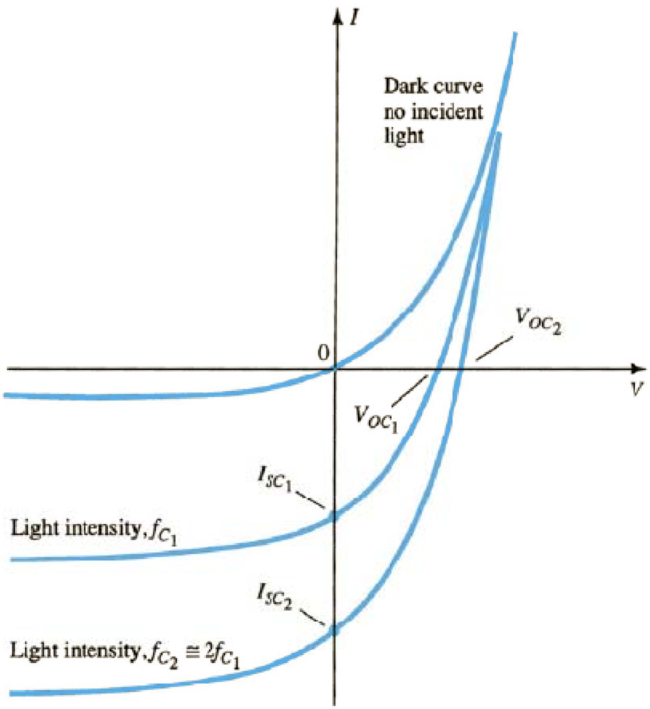
Outros Dispositivos

Células solares

Células solares:

- São dispositivos construídos a partir de materiais semicondutores e que são sensíveis à luz.
- Geram potências da ordem de mW quando iluminados.





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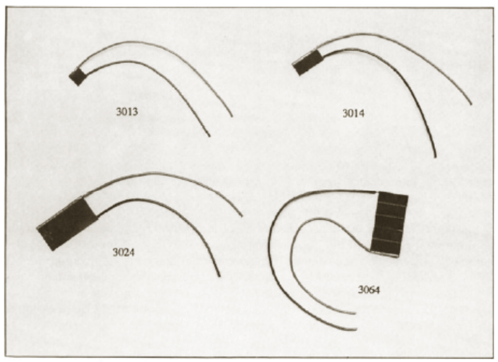
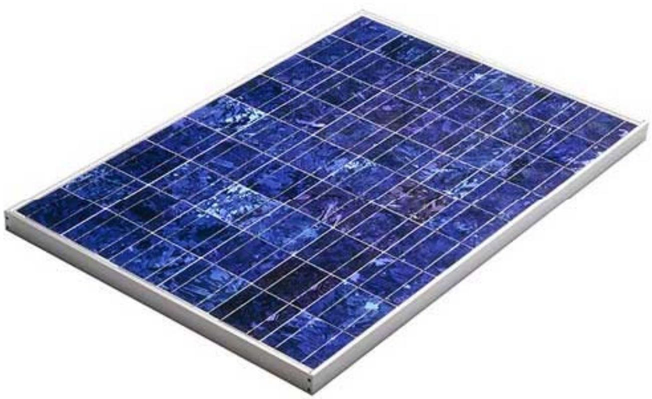


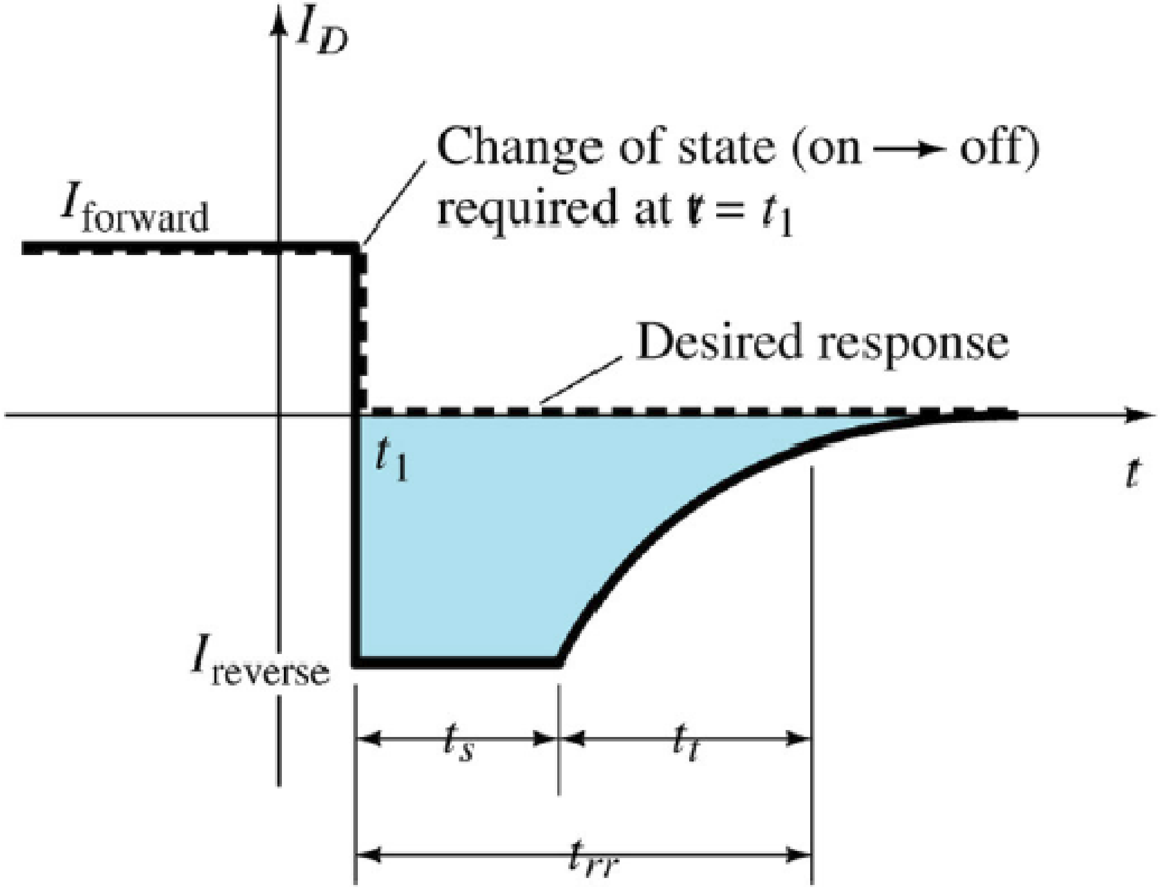


Semicondutores de Carbeto de Silício

Diodos de silicon carbide

Principal característica:

- Diminuem acentuadamente o fenômeno da **<u>recuperação reversa</u>**.



http://www.infineon.com

http://www.cree.com

Diodos de silicon carbide x silício (SiC x Si)

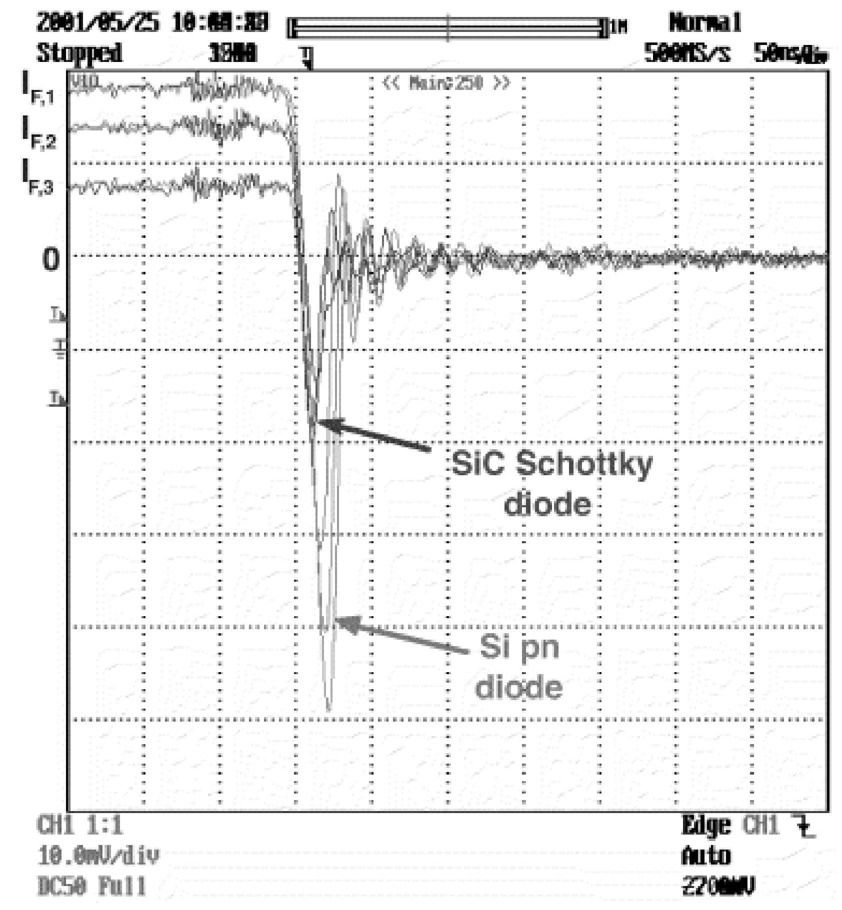


Fig. 5. Typical reverse recovery waveforms of the Si pn and SiC Schottky diode for three different forward currents (2 A/div.).

http://powerelec.ece.utk.edu/pubs/pels_letters_SiC_june_2003.pdf

Diodos de silicon carbide x silício (SiC x Si)

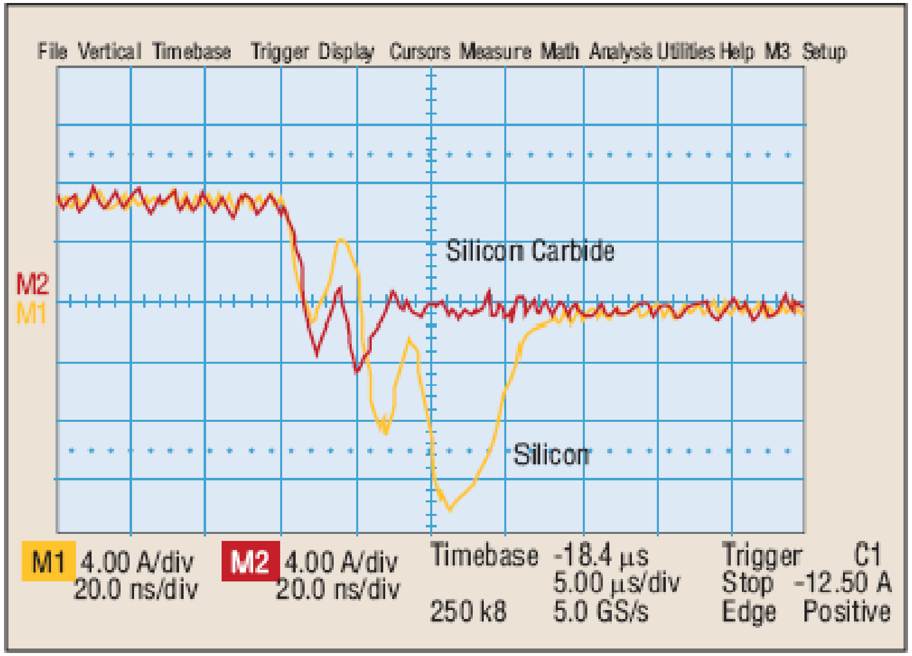


Fig. 4. *Low-line diode recovery currents in PFC front-end converter.*

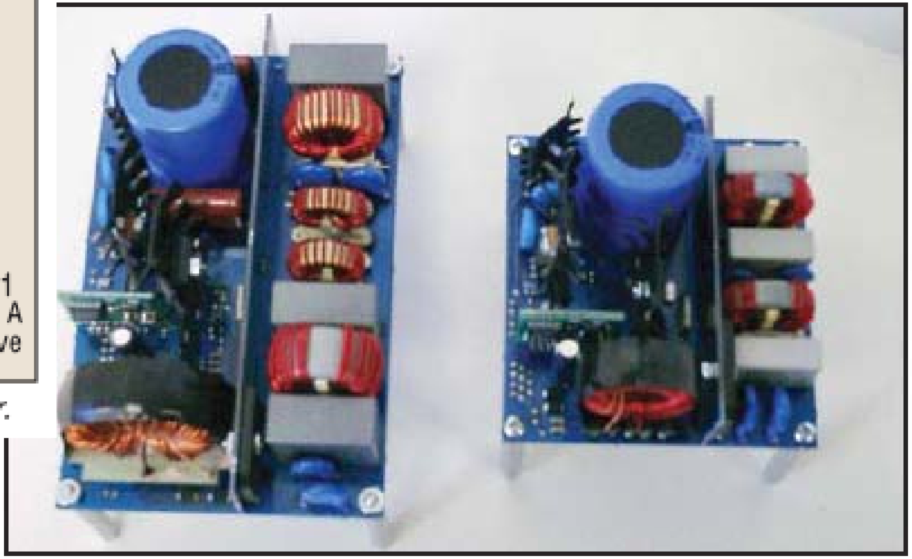


Fig. 8. *A size comparison of an 80-kHz PFC front-end built with Si rectifiers (left) and a 200-kHz PFC front-end with SiC rectifiers.*

http://www.cree.com/Products/pdf/Power_Article_1.pdf

Diodos de silicon carbide

C2D20120D–Silicon Carbide Schottky Diode

ZERO RECOVERY® RECTIFIER

V_{RRM} = 1200 V
I_F = 20 A
Q_c = 122 nC

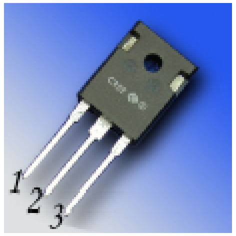
Features

- 1200-Volt Schottky Rectifier
- Zero Reverse Recovery
- Zero Forward Recovery
- High-Frequency Operation
- Temperature-Independent Switching Behavior
- Extremely Fast Swtitching
- Positive Temperature Coefficient on V_F

Benefits

- Replace Bipolar with Unipolar Rectifiers
- Essentially No Switching Losses
- Higher Efficiency
- Reduction of Heat Sink Requirements
- Parallel Devices Without Thermal Runaway

Package



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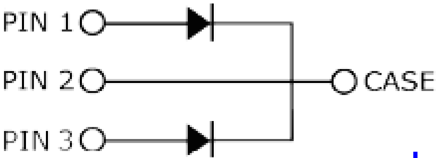


http://www.cree.com

LEDs de silicon carbide

The Real Color DisplayT, a moving sign which is capable of displaying the full range of colors, made possible by the use of blue LEDs.

New Products: Blue LEDs and Silicon Carbide Wafers

The ATP project has been highly productive for Cree and the economy at large. The company has used the new technology to produc larger silicon carbide wafers to use in its fabrication process for blue LEDs. It is also offering the larger silicon carbide wafers for sale t companies.

Cree is using the ATP-funded technology to reduce the cost of producing blue LEDs, and their sales have increased substantially. Production cost is primarily a func the number of wafers processed. If wafer size can be increased dramatically, the cost per device will decrease dramatically because so many more devices can be n on a wafer. The silicon carbide wafer technology is also aimed at markets for other blue light-emitting optoelectronic devices, optical disk storage, microwave communications, and blue and ultraviolet laser diodes, as well as high-temperature, high-power, and high-frequency semiconductors.

Benefits for the Economy

Benefits from the new silicon carbide technology are already accruing to customers who have bought large volume carbide wafers to use in their own production. Performance measures (resistance, power output, sensitivity to light for silicon carbide devices are frequently large, relative to available alternatives. Economic benefits from these perfo spill over to other producers involved in fabrication and assembly before a wafer-based product reaches the end use incremental benefits is expected to be much larger than the profits Cree receives for selling the silicon carbide wafe

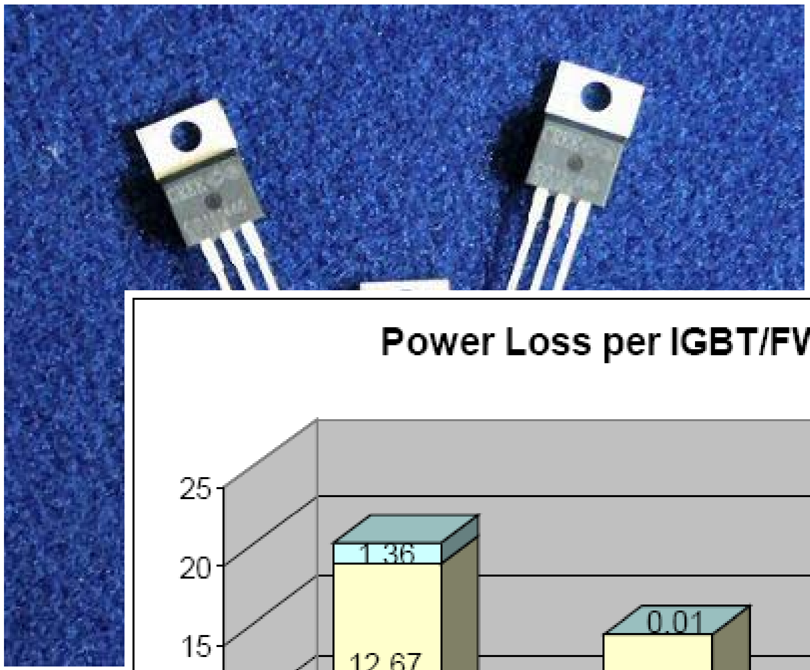
Cree's private success has led to public benefit, which is expected to grow as the number of applications for larger increases. Westinghouse, for example, used Cree's silicon carbide wafers in fabricating components for the transn commercial-level HDTV broadcast in the United States, in 1996. Westinghouse said its transmitter can deliver thre longer life and costs less to produce than conventional silicon-based transmitters. Although the number of HDTV tr silicon carbide wafers is unknown at this time, widespread use of this technology in HDTV broadcasting could proc economic benefits if it speeds commercialization of HDTV.

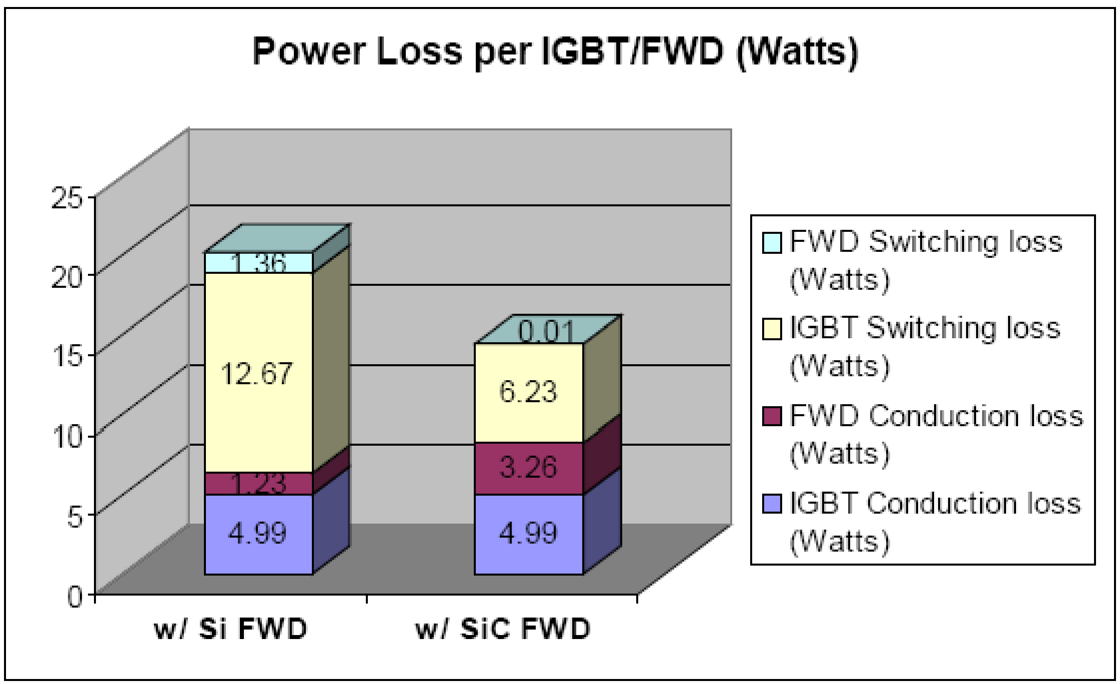
ATP Advantages

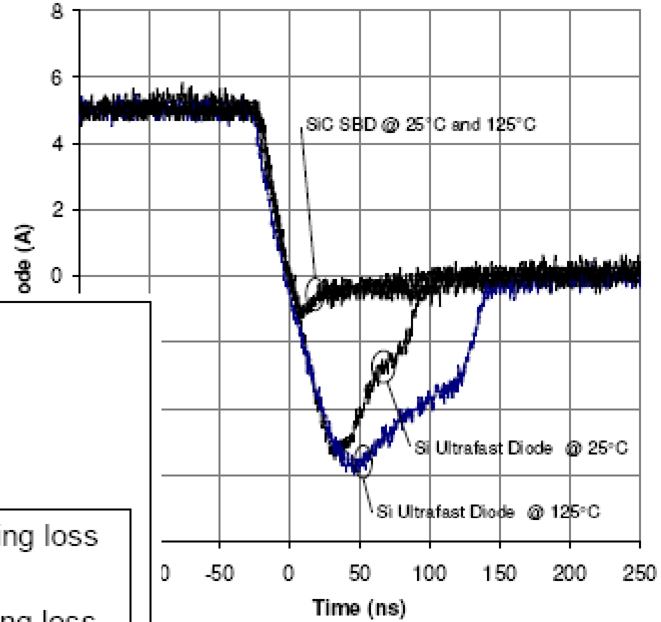
Cree reports it was attracted to the ATP as a funding source for the development of the bulk crystal and epitaxial g because the company could retain its process technology knowledge. The ATP award also helped Cree form allian work, enabling the company to get results about 18 months sooner than it would otherwise have been able to do. D

http://www.atp.nist.gov/eao/sp950-2/chapt4-5.htm

IGBTs de silicon carbide





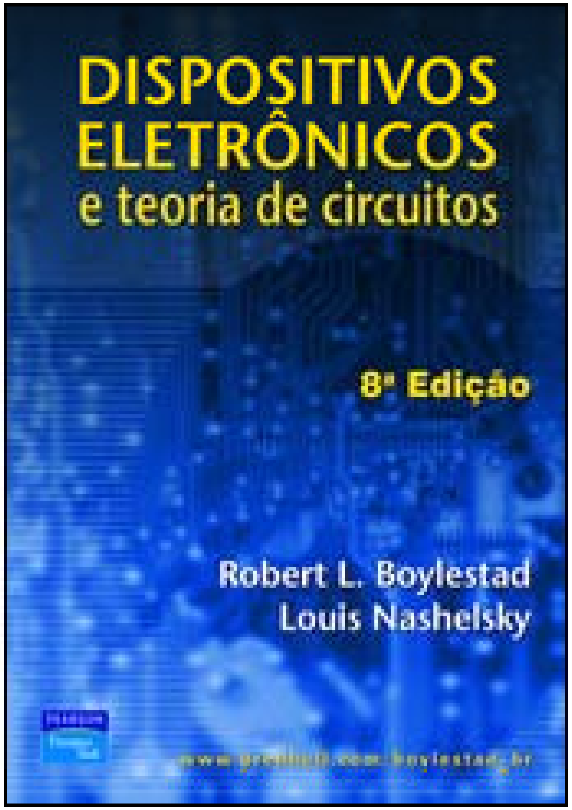


http://www.cree.com/products/pdf/CPWR-AN03.B.pdf

Na próxima aula

Seqüência de conteúdos:

1. Aplicações de diodos – Parte 1.



www.cefetsc.edu.br/~petry