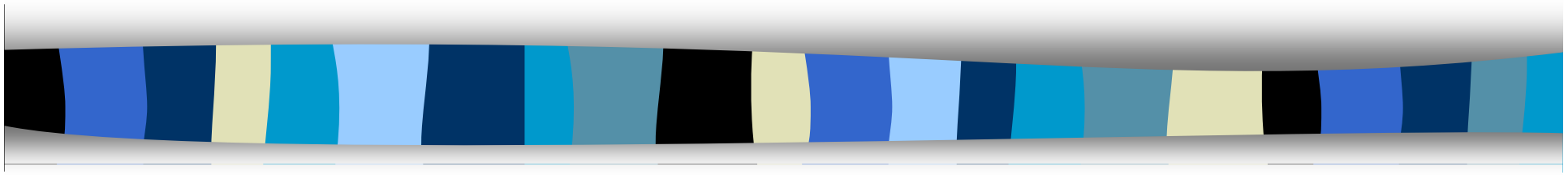
Avalanche



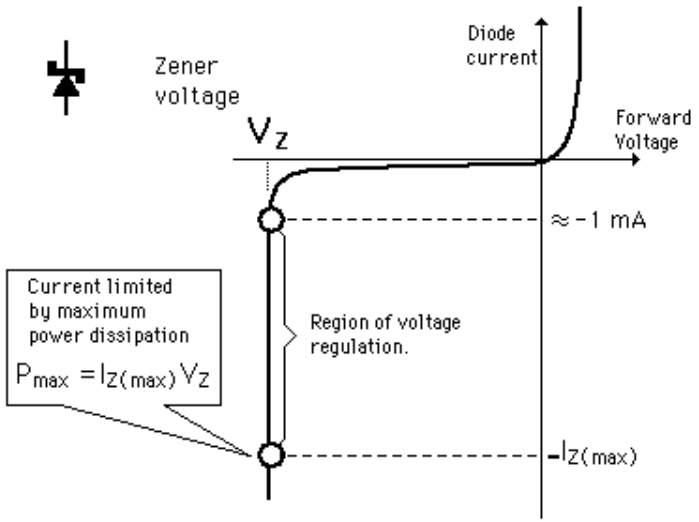
Breakdown

What is Breakdown?

- Deleterious effect that occurs in the presence of **high electric field.**
- Causes **high resistance** elements to allow flow of **high current.**
- Typically an irreversible effect permanently damaging the element.

Avalanche/Zener Breakdown

- 'Zener diode' and 'avalanche diode' are terms often used interchangeably.
- Both refer to breakdown of a diode under reverse bias.



Avalanche/Zener Breakdown (con't)

- Avalanche occurs with lightly doped PN junctions. (*Multiplication* effect).
- Zener occurs in highly doped junctions (quantum *tunneling* effect).

Avalanche/Zener Breakdown (con't)

- ***Reverse bias*** = Very little current flow
  = Open circuit

- As Reverse voltage ↑ a point is reached where current ↑ dramatically, therefore dynamic resistance ↓.

Avalanche Breakdown

Avalanche breakdown causes high flow of current under **reverse bias** condition!

The question is: How does this happen?

Avalanche Breakdown (con't)

Reverse bias ⇨ Thick *depletion region* causes high *electric field* and tremendous *acceleration*

⇨ Very few electrons make it through depletion region with high velocity

⇨ These electrons collide with atoms in the depletion region and free more electrons (Process called *Multiplication*).

⇨ Results in higher and higher current flow

Avalanche Breakdown (con't)

- An empirical relationship used to describe avalanche breakdown:

M=Multiplication factor= 1/(1-|V/Vbr|^n)

Avalanche Breakdown (con't)

By analogy, the process is named because a single carrier can spawn literally thousands of additional carriers through collisions, just as a single snowball can cause an avalanche.

Avalanche Breakdown (con't)