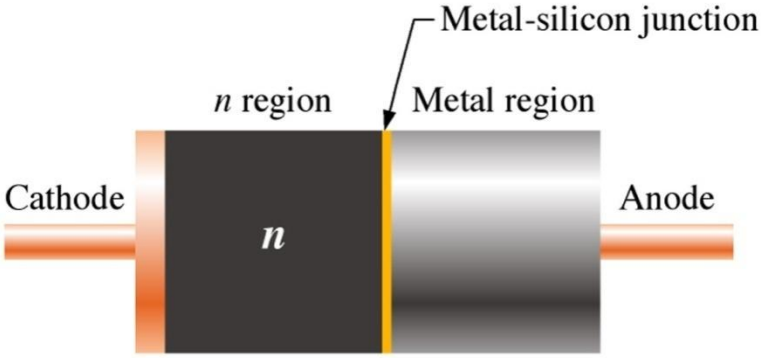
Lecture-5

Schottky Diode

The Schottky diode's (hot-carrier diodes) significant characteristic is its fast switching speed. This is useful for high frequencies and digital applications. It is not a typical diode in that it does not have a p-n junction. Instead, it consists of a lightly-doped n-material and heavily-doped (conduction-band electrons) metal bounded together.

Response is very quick…high speed digital communications.



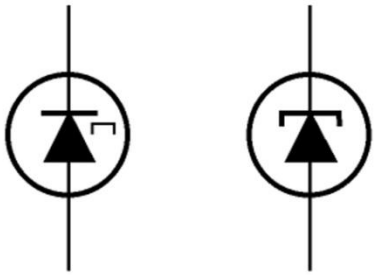
Lightly doped

Heavily doped (conduction-band electrons)

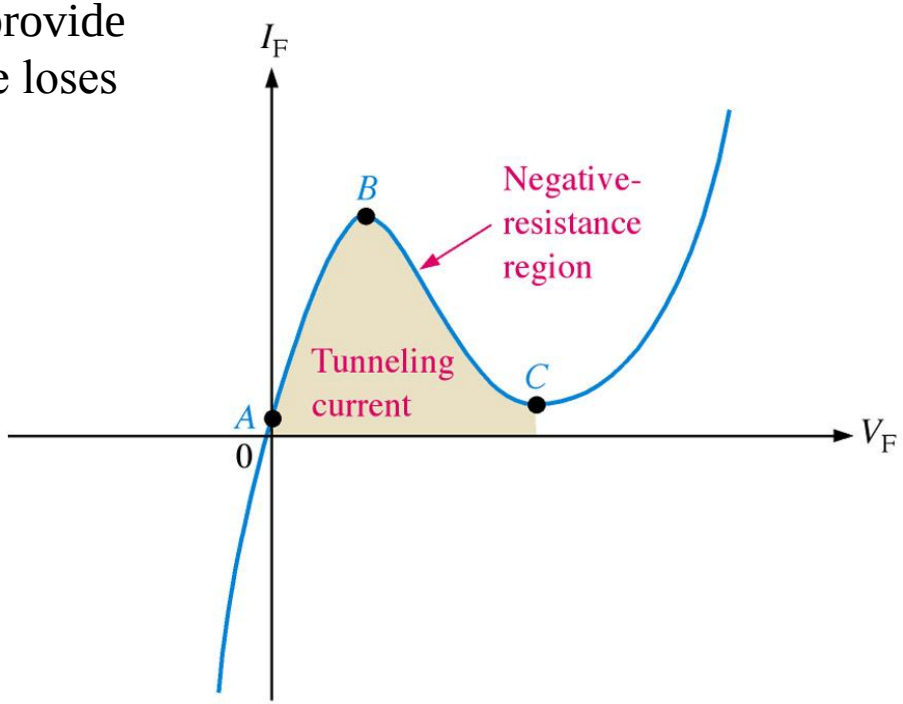
Tunnel Diode

The tunnel diode exhibits negative resistance. It will actually conduct well with low forward bias. With further increases in bias it reaches the negative resistance range where current will actually go down. This is achieved by heavily-doped p and n materials that create a very thin depletion region which permits electrons to "tunnel" thru the barrier region.

Tank circuits oscillate but "die out" due to the internal resistance. A tunnel diode will provide "negative resistance" that overcomes the loses and maintains the oscillations.



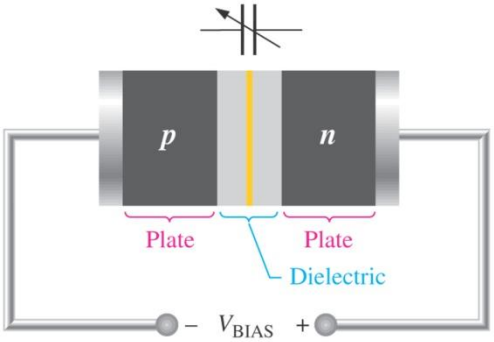
Germanium or Gallium



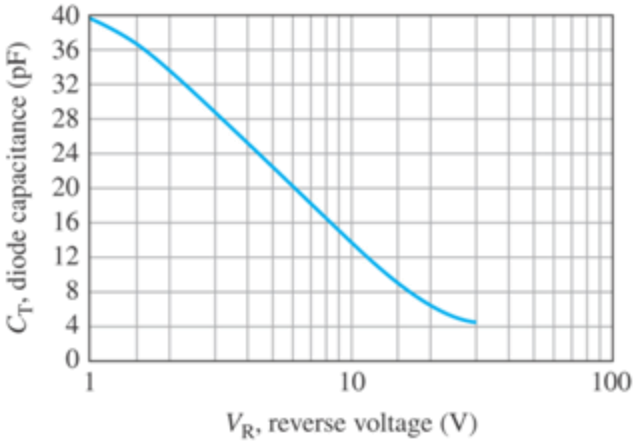
Varactor Diodes

- Operate in reverse bias
- Dielectric is acting as capacitor
- C capacitance, A=plate area, d=thickness

$$C = \frac{A\varepsilon}{d}$$



V_R ; Depletion Region ; Capacitance ; Plate Separation

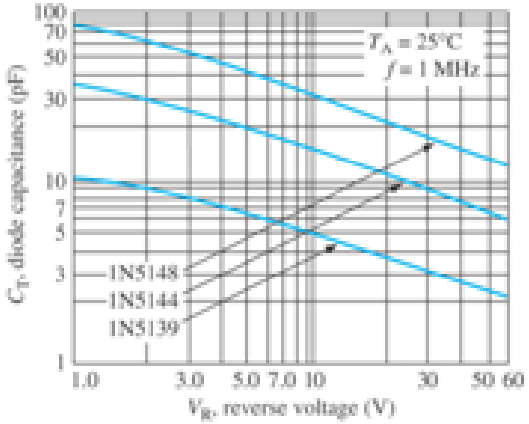


Varactor 

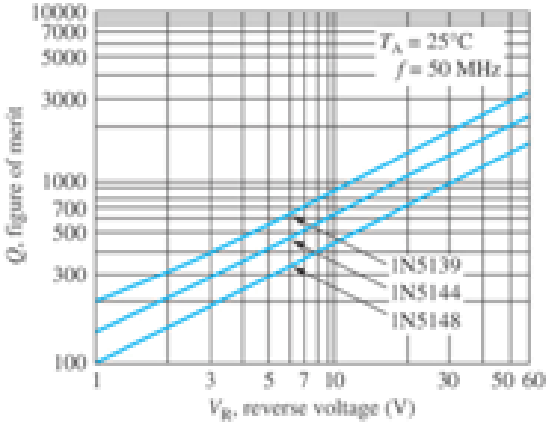
- Tuning Ratio (TR)
  - Nominal Capacitance is typically given (47 pF at V_R=4 V)
- Example: 1N5139
- Applications
  - Tuning circuits in TV to set the resonant frequency
  - Bandpass filter (R+(L||C))

$$TR = \frac{C_{V_R(\min)}}{C_{V_R(\max)}}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$



(b) Diode capacitance

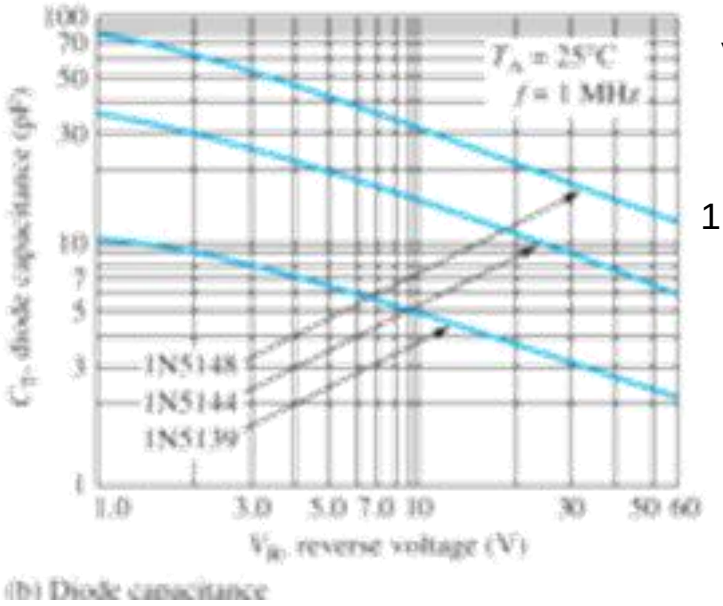


(c) Figure of merit

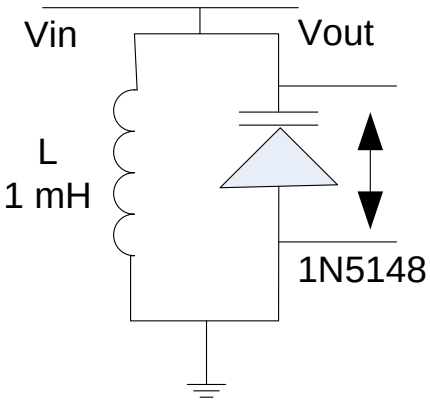
Varactor Diodes Example

- Accume
  - Vcont(min) = 2.9
  - Vcont(max) = 29
- Hence
  - C2.9 = 55 pF
  - C29 = 17 pF

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$



(b) Diode capacitance



f_{min} = 679 MKhz
f_{max} = 1.22 MHz