

VARACTOR DIODE

In a PN junction a very thin depletion region (acts as an insulator) of the order of 5×10^{-8} exists on either side of the 'P' and 'N' regions and it separates the 'P' and 'N' regions which act as conducting plates, as a result this capacitor is formed.

The capacitance may be varied by varying the reverse voltage applied to it thus, the varactor diodes also known as VVC (Voltage Variable Capacitance) diode. In other words the varactor diode is a semiconductor, voltage dependent, variable capacitor diode. Their mode of operation depends on the capacitance that exists at the PN junction when it is reverse biased.

The depletion region in a PN junction forms a barrier which separates the positive and negative charges on the opposite plates of a diode and the depletion region acts like a dielectric. Thus PN junction possesses junction capacitance. The transition capacitance C_T established by the junction is determined by

$$C_T = \epsilon \frac{A}{W_d}$$

where, ϵ = permittivity of semiconductor materials W_d = the depletion width
As the reverse potential increases the width of the depletion region increases, which in turn reduces the transition capacitance. In terms of the applied reverse bias, the transition capacitance is given by

$$C_T = \frac{k}{(V_T + V_R)^n}$$

where,

k = constant

V_T = knee potential

V_R = magnitude of the applied reverse potential

$n = 1/2$ for alloy junctions, & $1/3$ for diffused junction

When the reverse bias voltage decrease, the depletion layer narrows down. This decreases the dielectric thickness, which increases the capacitance; figure 17 shows the variation of capacitance with the reverse voltage. This indicates that the variation of capacitance is maximum when the reverse voltage is equal to zero. It reduces in a non linear manner, as the value of reverse voltage is increased.

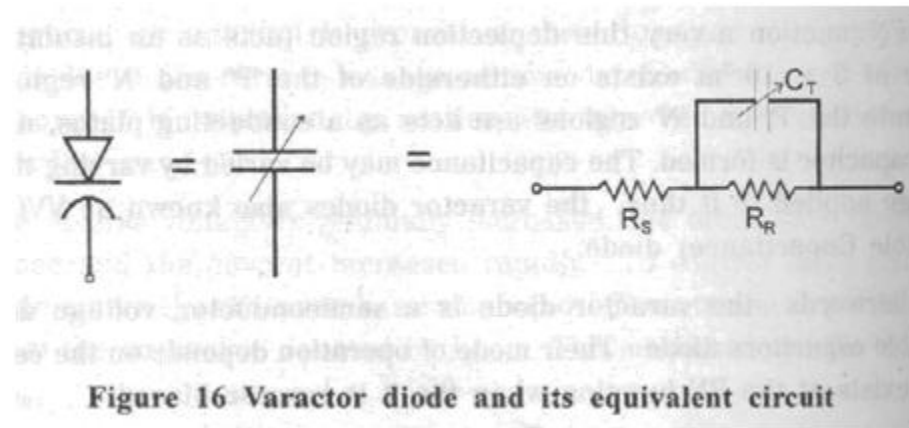


Figure 16 Varactor diode and its equivalent circuit

In this diode the variation of capacitance are controlled by the method of doping in the depletion layer or the size and geometry of diode construction. There are two types of doping used in varactor diode

(1). Abrupt doping

(2). Hyper doping.

Advantages of VVC over other variable capacitors

1.Smaller in size

2.Rugged and reliable

3.No movable part

4.Operate over wide range of frequencies

5.It has very fast response

Electrical tuning Applications

1.Because of large range of capacitance variation these diodes are used in Some of the high frequency areas like frequency modulation TV tuning and FM radio

2.In automatic-frequency control circuits

3.In adjustable band pass filters

4.In parametric amplifiers.

Source : <http://mediatoget.blogspot.in/2011/10/varactor-diode.html>