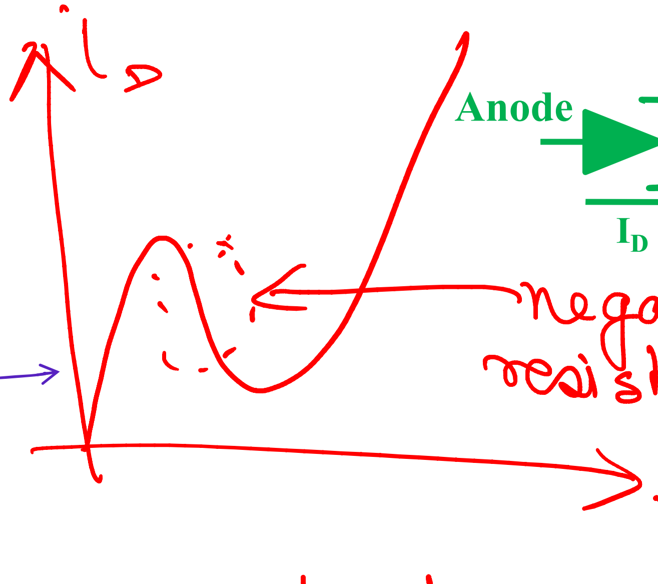
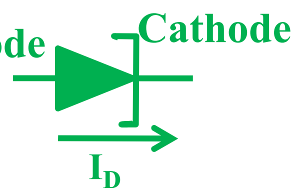
ESc201, Lecture 12: Diodes

- Tunnel Diode
- Varactor Diode
- Gunn Diode

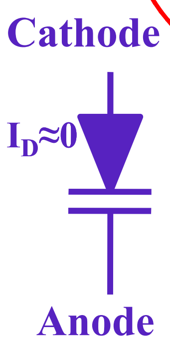
- Schottky Diode

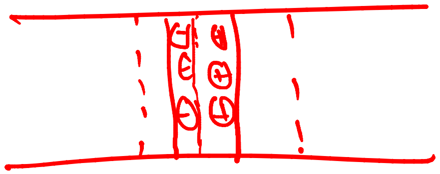


negative resistance

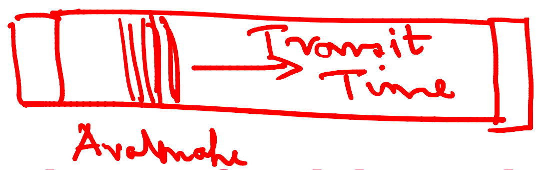


Used as an oscillator





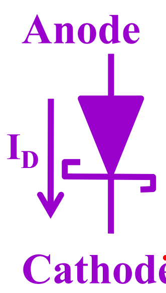
With bias the depletion width increases or decreases
∴ Separation of charge (Capacitor)
Capacitance Value can be varied with applied voltage



Termed as transferred electron device.

Used as a high (GHz) frequency oscillator
But not much used now as the powers of these are very low.

It can also use as an amplifier.



Metal / Semiconductor Junction
Holes and electrons do not conduct current. Only movement of electrons.
These are fast diodes (For high speed operation)

Low cut in voltage ($V_\gamma \approx$ 0.1-0.2V), low B_V, low capacitance

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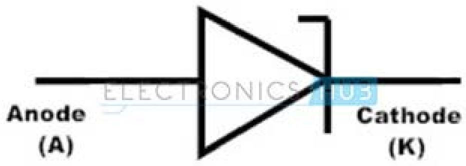
– **Avalanche Breakdown Diode**



specially designed to undergo breakdown at specific reverse voltage to prevent the damage.

– **Step Recovery Diode**

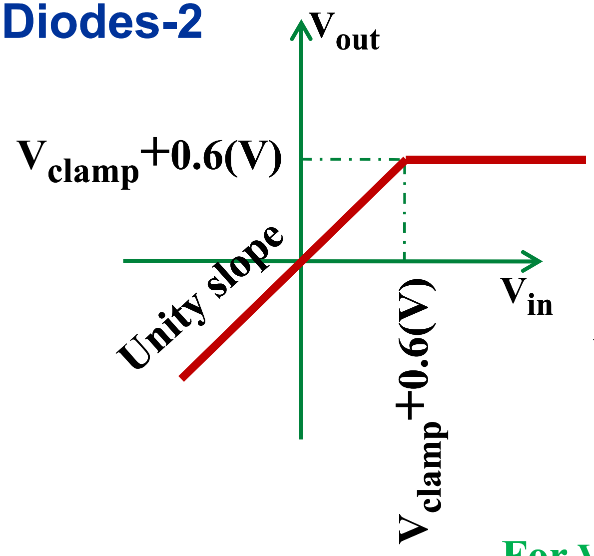
Stores the charge from positive pulse and uses in the negative pulse of the sinusoidal signals. The rise time of the current pulse is equal to the snap time. Due to this phenomenon it has speed recovery pulses.

Cut-off frequency range of 200-300 GHz. In the operations which are performing at 10GHz range these diodes plays a vital role.

ESc201, Lecture 14: Diodes-2

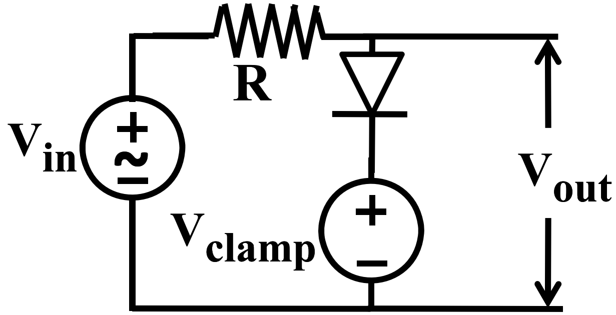
Diode Applications:

– Clamping
– Clipping
– Wave-shaping
– Peak Detection
– Peak-to-Peak Detection
– Rectification (AC to DC)
• Half-wave
• Full-Wave
• Bridge

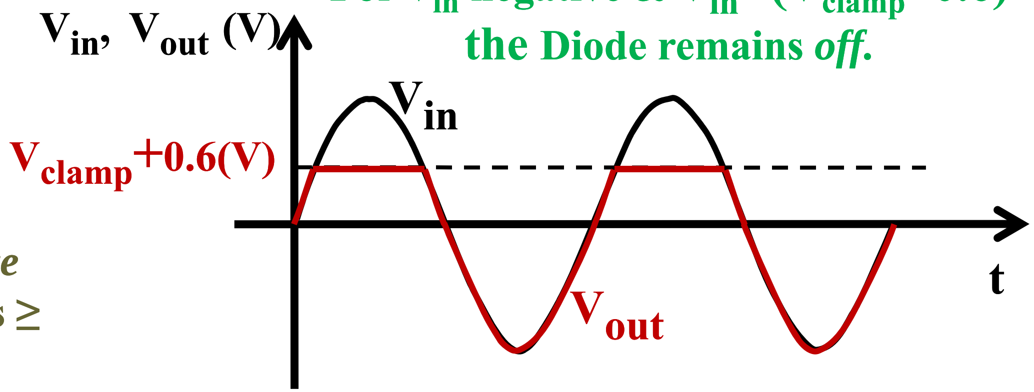


Diode Clamping Circuit:

Voltage Transfer Characteristic using model with V_{on}= 0.6V and r_F=0.

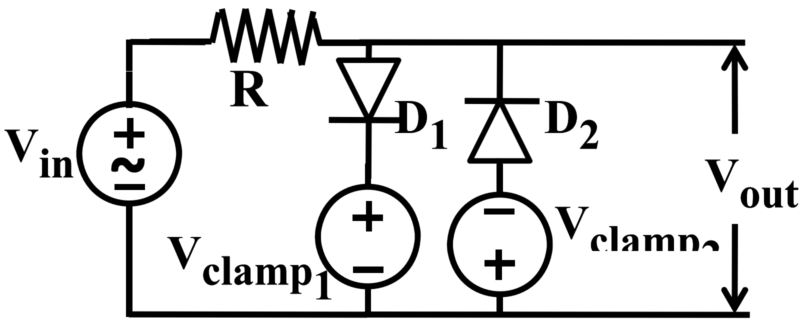


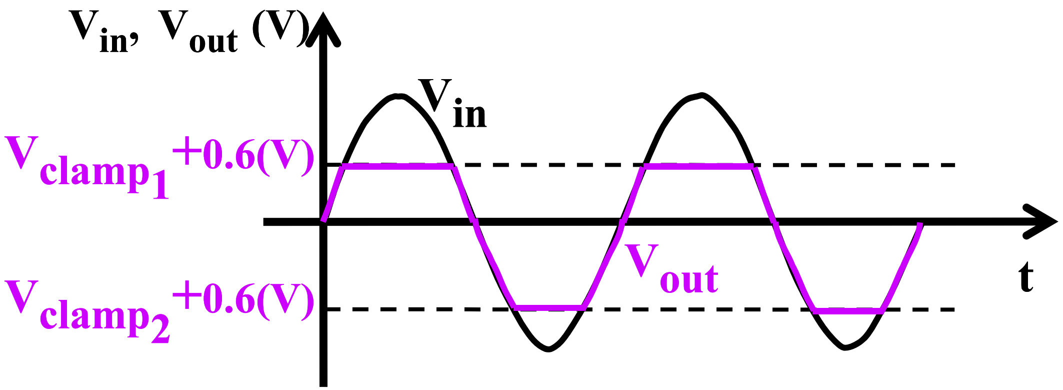
For V_{in} negative & V_{in}<(V_{clamp}+0.6) the Diode remains *off.*



Dual Clipper

Clipping of input waveforms in both *+ve & –ve* half cycles. D_1 conducts if its anode voltage is ≥ V_{in} and D_2 conducts if its cathode is ≤ V_{in}.

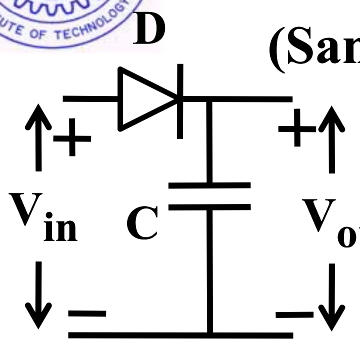




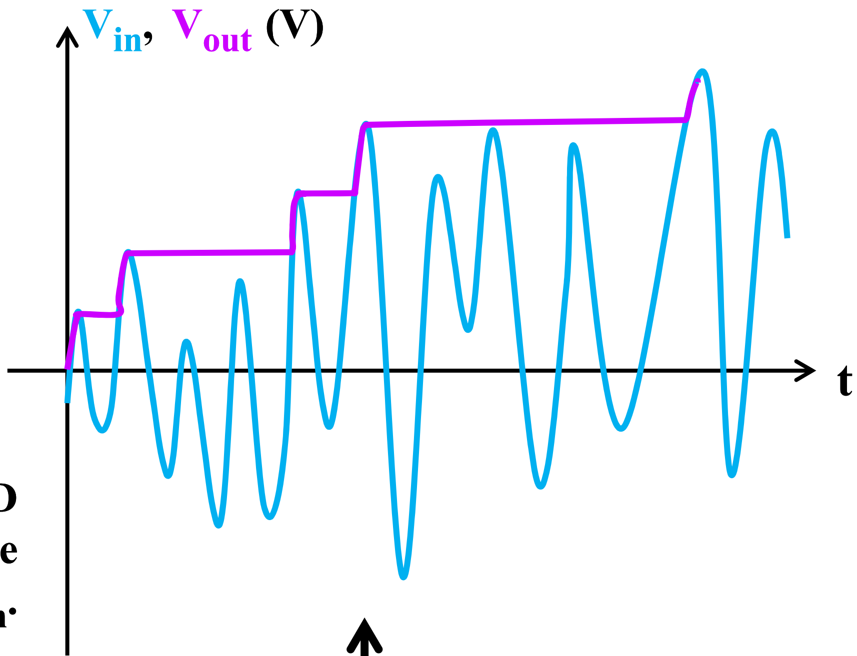
ESc201, Lecture 14: Diodes-2

Peak (or Envelope) Detector

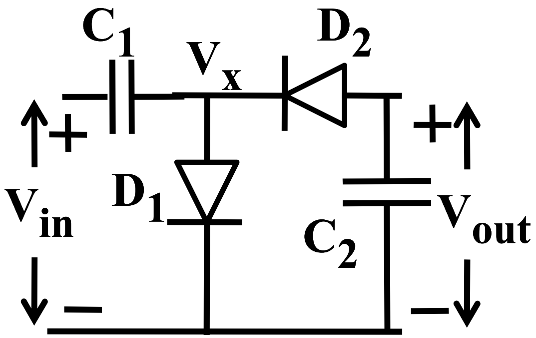
(Sample and Hold Circuit)



If C is initially completely discharged, V_{out} will follow V_{in} whenever D is forward biased (assuming ideal diode). However, as soon as V_{in} starts to decrease beyond its maximum value, D immediately gets reverse biased and C stores the charge corresponding to the *last peak value of* V_{in}. (Nowadays much better options are availabile).

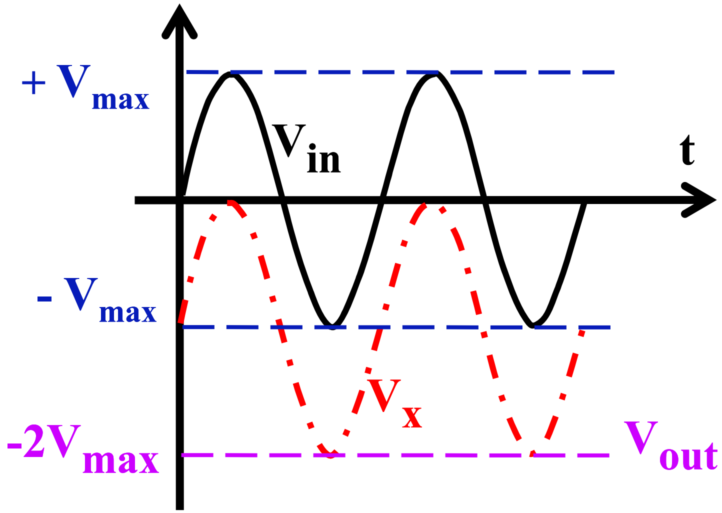


Peak-to-Peak Detector



+ve diode clamp | -ve peak detector

Measures the peak-to-peak value of the input signal and holds (or clamps) that value at the output. It consists of 2-blocks i.e. a +ve diode clamp (C_1-D_1), and a -ve peak detector (C_2-D_2). For positive V_{in}, D_1 gets forward biased and clamps V_x to 0 V. C_1 gets charged to V_{max}. Or $V_x = -(V_{c_1} - V_{in})$.



V_{c_1} remains clamped at V_{max} whereas the *maximum and minimum* values of V_{in} are $+V_{max}$ and $-V_{max}$. V_x swings between 0 and $-2V_{max}$. V_{out} gets clamped at $-2V_{max}$. But the input need not be symmetric.

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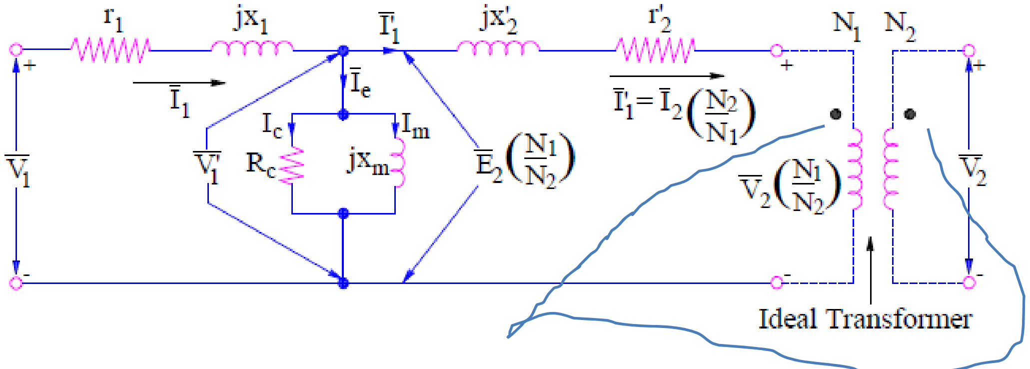
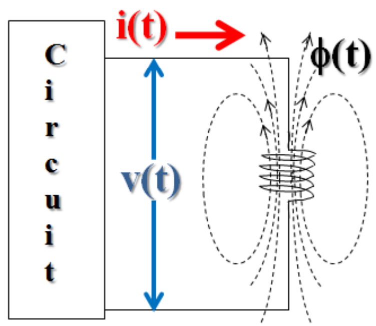
Transformer Equivalent Circuit Referred to Primary Side



Transformer

Inductor

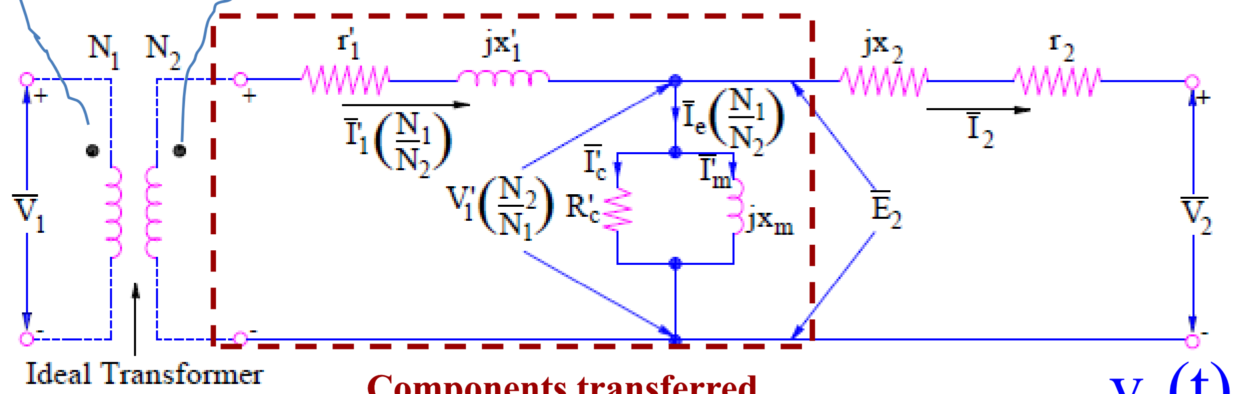


$$\phi(t) = L \times i(t)$$

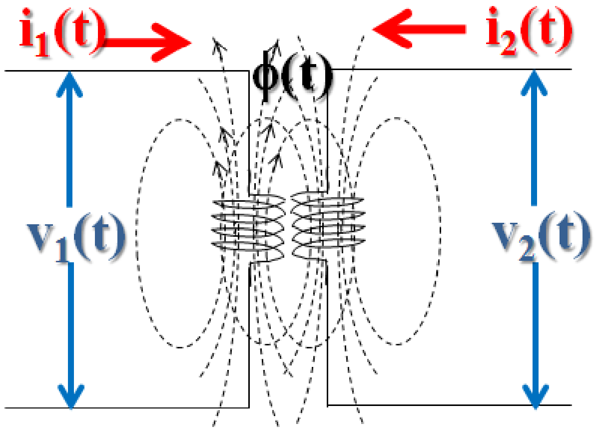
$$v(t) = L\frac{di(t)}{dt}$$

The DOTs show polarity OR it indicates how the wires are wound

Transformer Equivalent Circuit Referred to Secondary Side



Components transferred from primary to secondary



$$v_1(t) = L_1\frac{di_1(t)}{dt} + M_{12}\frac{di_2(t)}{dt}$$

$$v_2(t) = L_2\frac{di_2(t)}{dt} + M_{21}\frac{di_1(t)}{dt}$$

In most cases M_{21}=M_{21}=M