Lecture 3

Clipper Circuits

Clipper circuit is the circuit which clip off a portion of the input signal without distorting the remaining part of the signal

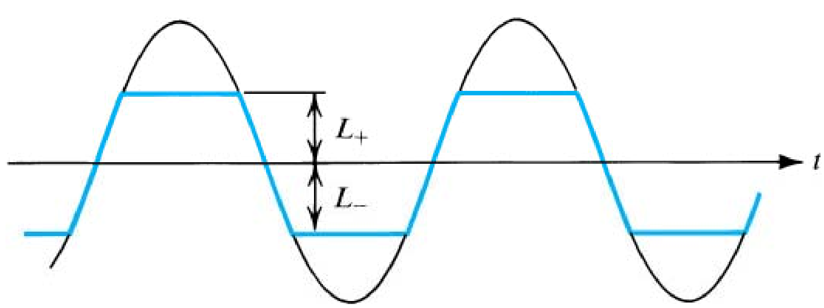
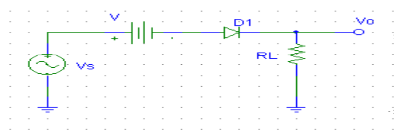


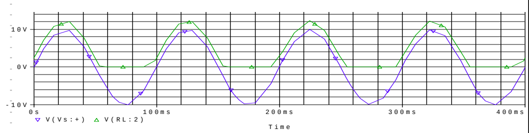
Figure 3.33 Applying a sine wave to a limiter can result in clipping off its two peaks.

Clippers

- ***Clipper*** circuits is used to remove one part of the signal without distorting the remaining part.
- The orientation of the diode determines the part of the signal that is removed, while the value of the DC controls the level of clipping.
- It is usually consists of , a diode, a resistance and a DC source.
- Clippers have two major configurations;
  - Series Configuration, where the diode is connected in series with the the source.
  - Parallel Configuration; where the diode is connected in parallel with the output port.
    - ***Single Side Clippers*** ***Double Side Clippers***

• Series Clippers

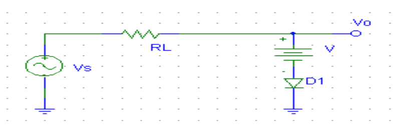


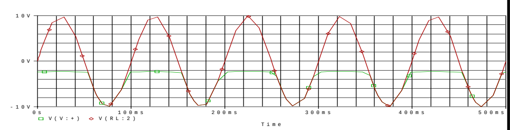


- The output voltage is given by KVL as;
- $\boldsymbol{v_o = v_s - V - V_D}$ such that the voltage at the diode input has to be greater than V_T for the diode to conduct. Otherwise, the diode will be off and v_o will be zero.

Parallel Clippers

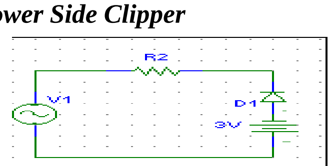
Upper Side Clippers:

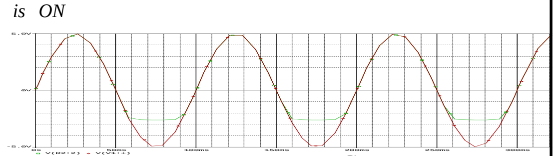




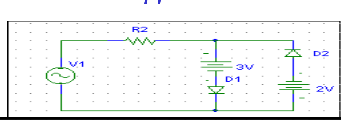
$$v_0 = \begin{cases} v_i & \text{if } D \text{ is } OFF \\ v_D + V & \text{if } D \text{ is } ON \end{cases}$$

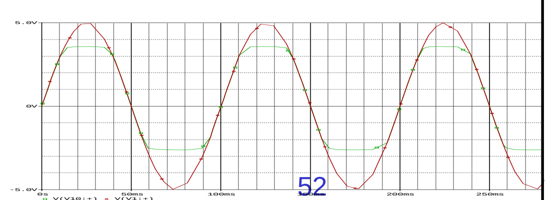
Lower Side Clipper





Double Side Clipper





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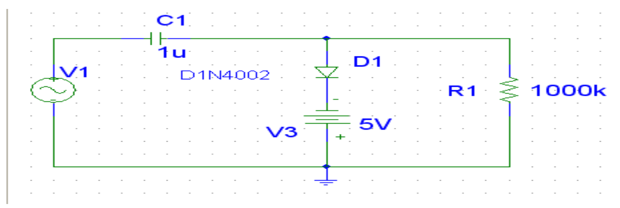
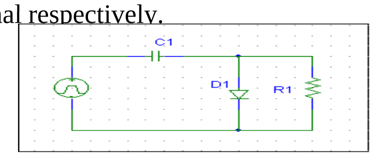
Clampers

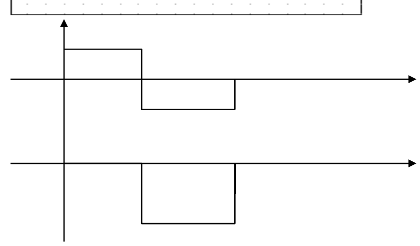
- A clamping circuit is the circuit that is used to clamp a signal to a certain DC level.
- It must contain a capacitor, a diode and a resistive element.
- The value of the *discharging* time constant of the capacitor, τ_{dis}=RC>>T/2 has to be large enough to ensure that the capacitor doesn't discharge during the OFF period of the diode.
- The very small resistance of the diode R_D makes the *charging* time constant $\tau_{ch}=R_D C$ so small that its can be considered that the diode charges in zero time.



Clampers

- Rules:
  - The Direction of the diode's arrow determines whether the signal is clamped up or down.
  - The value of the DC source connected to the diode's anode determines the max or the min of the clamped signal respectively.
- Operation
  - For t=0 $\rightarrow$ T/2, D is ON





Resistance R1 is short-circuited by the diode.
  - C charges to V_m in zero time (theoretically).
  - For t=T/2 $\rightarrow$ T,D is OFF.
  - C discharges through R1
  - The Value of the output voltage is $-[V_s(V_m)+V_c(V_m)]$

Clampers

- Rules:
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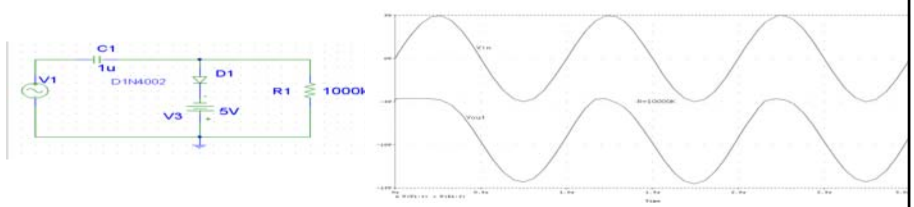
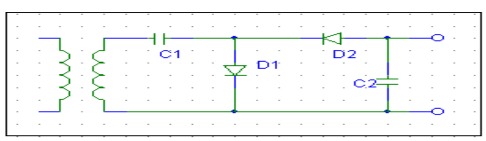


VOLTAGE MULTIPLIER CIRCUITS

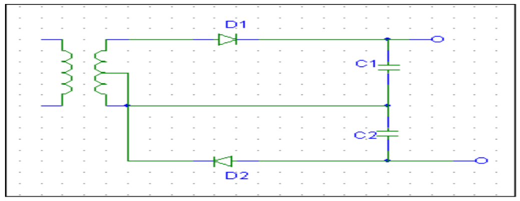
- Voltage multiplier circuits are used to maintain low transformer peak voltage and stepping up the voltage to 2, 3,or 5 times this value
- Voltage Doubler (Half-Wave)



During +ive half cycle, D1 ON, D2 OFF, C1 charges to $+V_m$

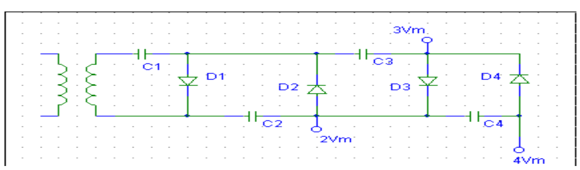
– During -ive half cycle, D1 OFF, D2 ON, C2 charges to $+2V_m$ as following;
$-V_{C2}+V_{c1}+V_m=0$
$VC2=Vc1+V_m=2V_m$

Full-wave Voltage Multiplier



- During (+)ive half cycle, D1 ON, D2 OFF, C1 charges to $+V_m$
- During (-)ive half cycle, D1 OFF, D2 ON, C2 charges to $+V_m$.
- So the total output voltage applied to the load is $2V_m$.

Voltage Tripler and Quadrupler



- During (+)ive half cycle , D1 ON, C1 charges to $V_{m.}$
- During (-)ive half cycle , D1 OFF, C2 charges to $2V_{m.}$through C1 and the secondary winding of transformer.
- During the next (+)ive half-cycle, D3 conducts, and C2 charges C3 to 2Vm