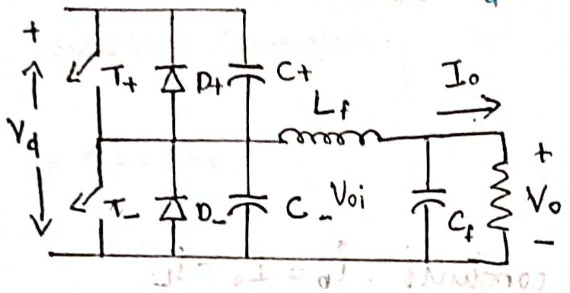
6/5/22. Zero voltage switching clamped voltage (ZVS - CV) Topology

Previous case : peak inverse voltage = $2V_d$.

modification is made to clamp reverse voltage to source voltage.

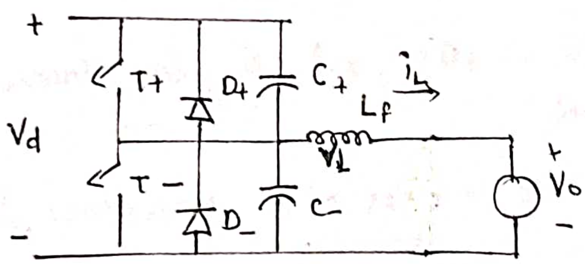
$C_+ = C_- = \frac{C}{2}$ — selected such that $f_0 = \frac{1}{2\pi\sqrt{L_f C}}$ is very large compared to switching freq.



① switches turn on and turn off at zero voltage

② Peak voltage across switch is clamped to the i/p DC voltage.

③ C_f is considered as very large and hence load is replaced by a voltage source. V_o.



<u>Initial condition - before t_0</u>

① T_+ is on & T_- is off

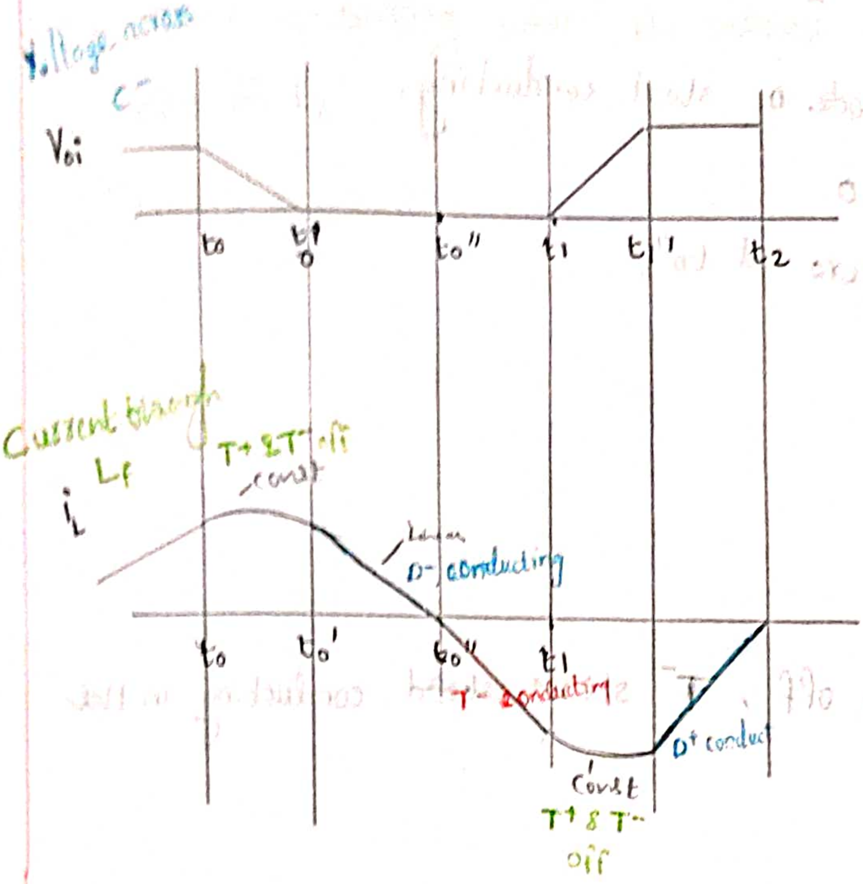
② $V_L = V_d - V_o$ (constant)

③ D_+ & D_- reverse biased.

④ $V_{C+} = 0$ & $V_{C-} = V_d = V_{oi}$

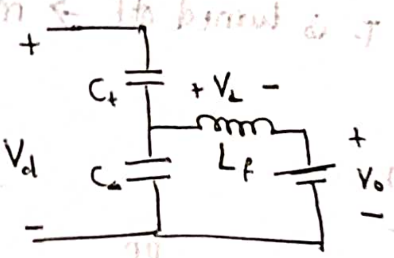
⑤ $V_{T+} = 0$

At $t = t_0$, T_+ is turned off at zero voltage due to V_{C+}.

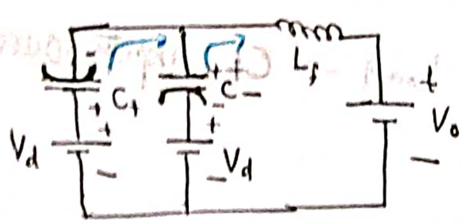


$t_0 \rightarrow t_0'$

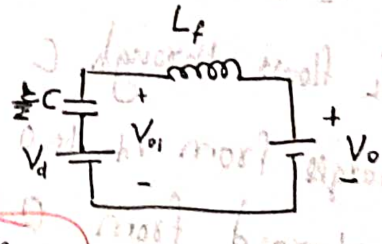
① T+, T−, D+ and D− are in off state.



② Since C_- has an ~~equ~~ voltage of V_d, equivalent circuit can be redrawn as



$\Rightarrow$



Thevenin equivalent

$C = C_+ + C_- = \frac{1}{2}C + \frac{1}{2}C = C$

③ Inductance current $i_L = I_o = i_{C+} + i_{C-}$

④ V_{c+} changes linearly from 0 to V_d.

⑤ $\therefore$ decreases linearly from V_d to zero.

$V_{c-} = V_{oi} = V_d - V_{c+}$

⑥ $C_+ = C_-$ } $i_{c+} = i_{c-} = \frac{i_L}{2}$

At t_0' : $V_{oi} = 0$, so diode D_- start conducting.

① $V_{c-} = V_{oi} = V_d = 0$

② i_L decreases linearly to zero at t_0''.

At :

At t_0'' when D^- becomes off, T^- starts ~~start~~ conducting in the -ve direction.

$t_0'' \rightarrow t_1$

i_L flows through $T-$ & $V_L = -V_0$

At t_1 $T-$ is turned off → maximum voltage that comes across T_+ is V_d.

$t_1 \rightarrow t_1'$

T_+ and T_- are off

Negative i_L flows through C

$C+$ discharges from V_d to 0 through Load → $C+$, input source.

C^- gets charged from 0 to V_d.

$t_1' \rightarrow t_2$

When V_{c+} is zero, $D+$ conducts negative i_L

$V_L = V_d - V_0$ is +ve ($V_d > V_0$ - current rises)

$\frac{di_L}{dt}$ is +ve.

T_+ ~~starts~~ is gated while D_+ ~~D_1~~ is conducting

T_+ starts conducting when D_+ become off when i_L is reduced to zero at t_2.