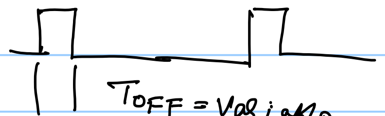
constant-ON time control

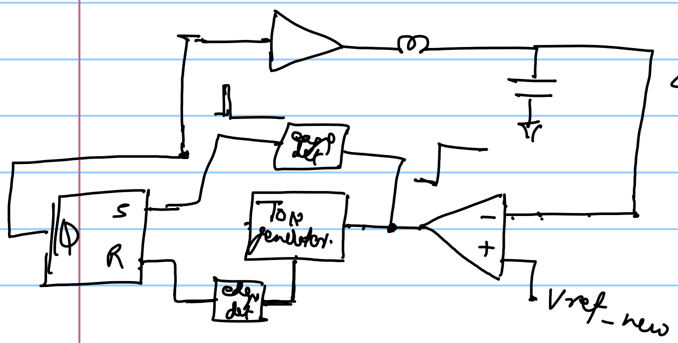
$V_o = D \cdot V_{dd}$

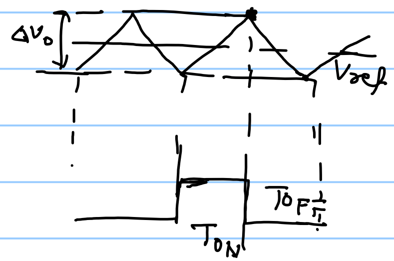


T_{ON} = constant T_{OFF} = variable

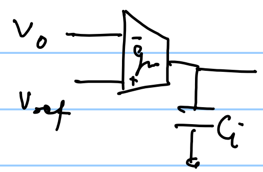
$$D = \frac{T_{ON}}{T_{SW}} = \frac{T_{ON}}{T_{ON} + T_{OFF}\nearrow}$$

$T_{SW} \longrightarrow$ Varying.



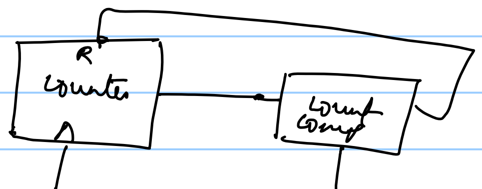


$$V_o = V_{ref} + \frac{\Delta V_o}{2}$$



$V_{ref\_new} = V_{ref} - \frac{\Delta V_o}{2}$

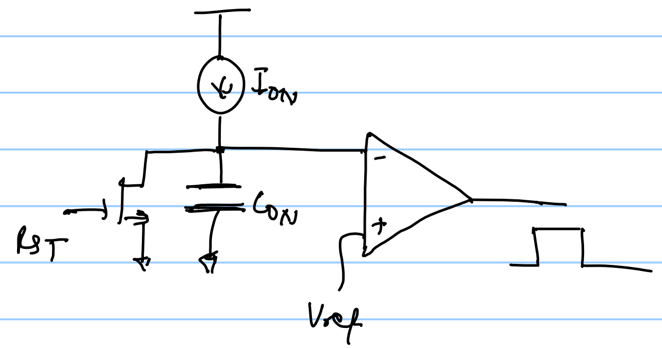
Digital T_{ON} generator.



Clock (high freq)
$100 \times f_{sw}$

ref_value = 10 for 100ns T_{ON}

(control from FLL for fixed freq)



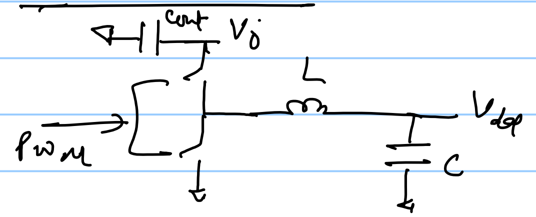
$$I = C\frac{dV}{dt}$$

$dt = T_{ON}$, $dV = V_{ref}$

$$T_{ON} = \frac{C_{ON}}{I_{ON}} \times V_{ref}$$

For Fixed freq. FLL can be used to control I_{ON} or V_{ref}.

Boost Converter



$$V_0 = D \cdot V_{dd}$$

$$V_0 \leq V_{dd}$$

$$V_0 \geq V_{dd}$$

$$V_0 = \frac{V_{dd}}{D}$$

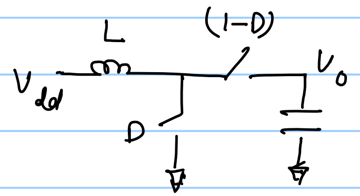
$$V_0 \propto \frac{1}{D}$$

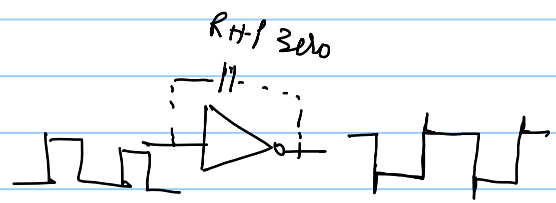
to get

$$V_0 \propto D$$

$$V_0 \propto \frac{1}{1-D}$$

$V_o = V_{dd}/(1-D)$





During ON Time Votage across inductor

Volt-second

$V_{dd} \times T_{ON}$

During OFF time

$(V_{dd}-V_0)T_{OFF}$

$V_{dd} \times T_{ON} + (V_{dd}-V_0)T_{OFF} = 0$

$V_{dd}\, D \cdot T_{sw} + (V_{dd}-V_0)(1-D)\, T_{sw} = 0$

$$D \cdot V_{dd} = V_o(1-D) - V_{dd}(1-D)$$

$$D \cdot \cancel{V_{dd}} = V_o(1-D) - V_{dd} + \cancel{D \cdot V_{dd}}$$

$$\boxed{V_o = \frac{V_{dd}}{1-D}}$$

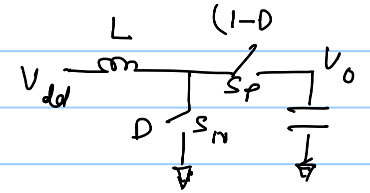
For ideal converter

$P_{out} = P_{in}$

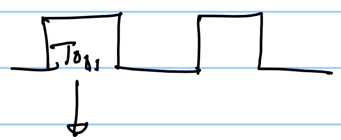
$$V_{out} \cdot I_{out} = V_{dd} \cdot I_{dd}$$

$$\frac{\cancel{V_{dd}}}{1-D} \cdot I_{out} = \cancel{V_{dd}} \times I_{dd}$$

$$\Rightarrow \boxed{I_{dd} = \frac{I_{out}}{1-D}}$$



R.H.P zero due to discontinuity in S_p switch



inductor is charging
but V_o is discharging → cause R.H.P zero.

$$\omega_z = \frac{(1-D)^2 R_{Load}}{L}$$

$L = 1mH$, $R_{load} = 5\,\Omega$

$D = 0.5$ ($V_{dd} = 2.5V$, $V_o = 5V$)

$$\omega_z = \frac{(0.5)^2\, 5}{1\mu H} = 1.25\ M\,rad/sec$$

$$f_z = \frac{1.25M}{2\pi} = 200\ KHz$$