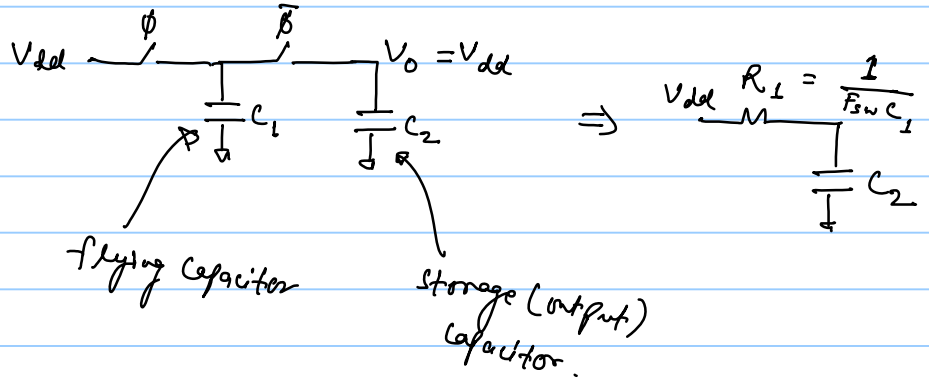
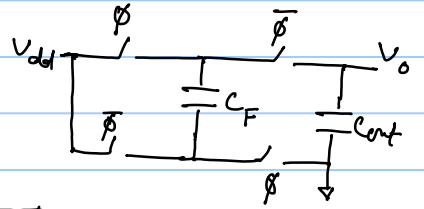
Switched Capacitor DC-DC converter

Switched capacitor is used as resistor



$\Rightarrow$

$V_o = 2 \times V_{dd}$

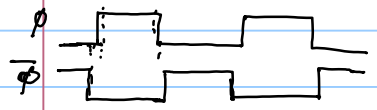


During ϕ, voltage in C_F

$V_{F\phi} = V_{dd}$

during $\bar{\phi}$,

$V_{F\bar{\phi}} = V_o - V_{dd}$



non-overlapped clocks.

$V_{F\phi} = V_{F\bar{\phi}}$

$V_{dd} = V_o - V_{dd}$

$\Rightarrow \boxed{V_o = 2V_{dd}}$ $\Rightarrow$ ideal case under no loss

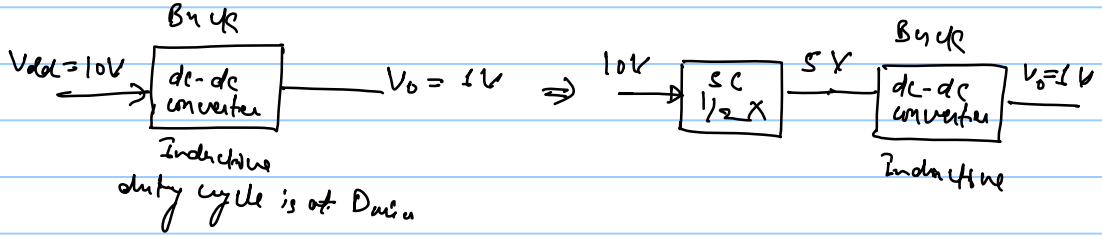
Under loss condition.

$V_o = 2V_{dd} - V_{loss}$

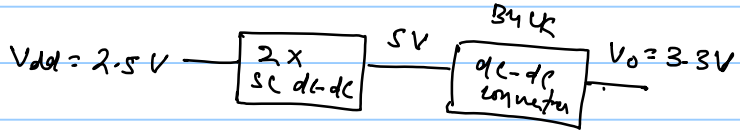
$V_{loss} \rightarrow I_{load}$

Open loop operation $\rightarrow$ output can't be regulated.

Applications in open loop.



$\Rightarrow$



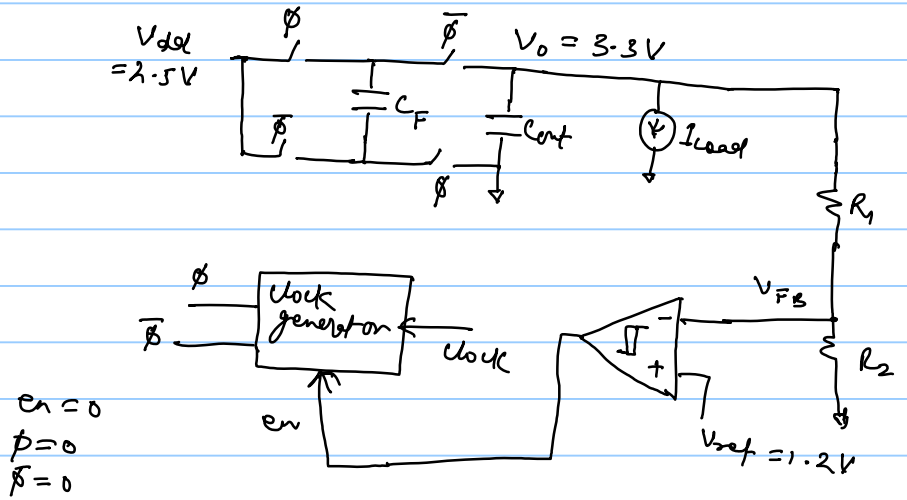
$I_L = \frac{1}{1-D} I_{Load}$ (boost)

① Better transient response → no R.H.P zero

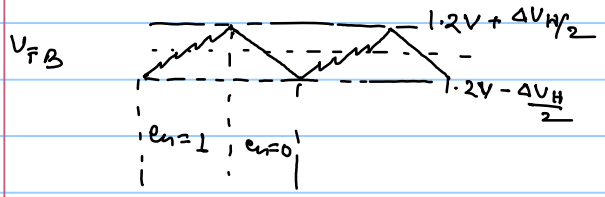
② Smaller output capacitor or smaller ripple with same cap.

③ Improved efficiency because $I_L = I_{Load}$ (buck)

Regulation V_{out} in SC dc-dc converter



$$\frac{V_{ref}}{V_o} = \frac{1.2}{3.3} = \beta$$



⇒ Similar to PFM operation in inductive dc-dc

In open loop.

$V_o = 5\,V$, $V_{dd} = 2.5\,V$ ⟶ efficient

$V_o = 3.3V$, $V_{dd} = 2.5$ (closed loop) ⟶ inefficient as $5V - 3.3V = 1.7V$ will be dropped.