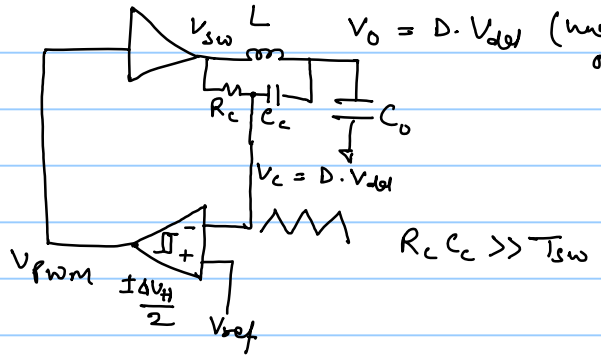
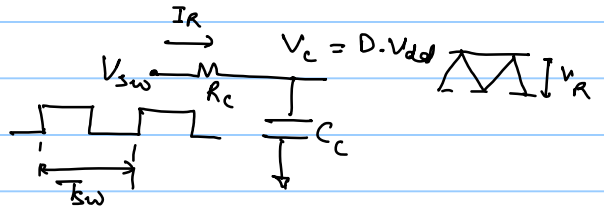
Current Mode Hysteretic converter



$V_o = D.V_{dd}$ (under no load condition or $R_{oter} \to 0$)

$R_c C_c >> T_{sw}$



charging current ($R_c C_c >> T_{sw}$) during T_{on}.

$$I_R = \frac{V_{dd} - V_c}{R_c}$$

$$I_R = C_c \frac{dv}{dt}$$

$$dV = \Delta V_H$$

$$dt = D \cdot T_{sw}$$

$$\Rightarrow \frac{V_{dd} - D \cdot V_{dd}}{R_c} = C_c \frac{\Delta V_H}{D \cdot T_{sw}}$$

$$\boxed{\frac{1}{T_{sw}} = \frac{V_{dd}(1-D) \cdot D}{R_c C_c \Delta V_H} = F_{sw}}$$

$$\Delta I_L = \frac{V_{dd}(1-D) D}{L} T_{sw}$$

$$F_{sw} = \frac{V_{dd}(1-D) \cdot D}{L \Delta I_L}$$

$$\Delta I_L \rightarrow \Delta V_H$$

$$L \rightarrow R_c C_c$$

In voltage mode hysteretic

$$F_{sw} = \frac{V_{dd}(1-D) D}{L \Delta V_H} \times R_{esr}$$

Voltage Mode Hysteretic

① Large R_{esr} → Large output ripple

② Frequency is depending on L & R_{esr}

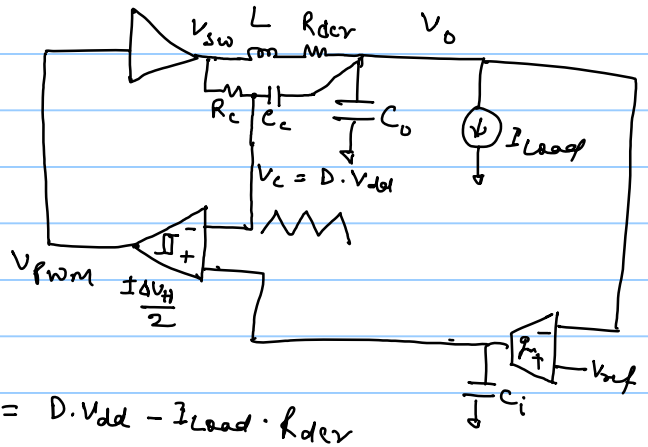
③ ΔV_H is small → V_{pwm} is sensitive to noise

Current Mode Hysteretic

④ Small R_{esr} (can be zero) → Small output ripple

⑤ Freq. is not depending on L & R_{esr}.

⑥ ΔV_H could be large so less sensitive to noise



$V_o = D \cdot V_{dd} - I_{Load} \cdot R_{esr}$

$V_c = D \cdot V_{dd}$

Since feedback is from V_c not V_o

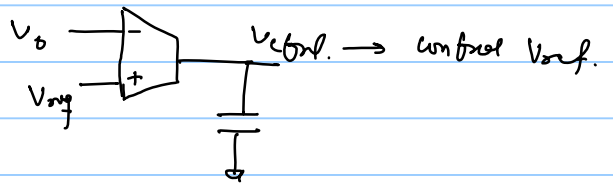
So there will be an error in V_o

$V_{error} = I_{load} \cdot R_{cdr}$

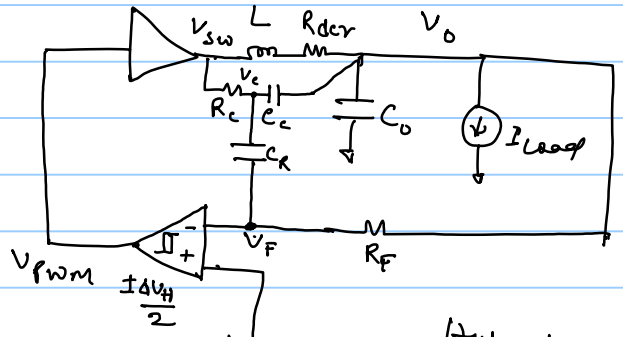
In order order to correct this error, V_{error} should be added to V_{ref}

$V_{ref} \longrightarrow V_{ref} + V_{error}$.

$V_{error} = V_c - V_o$



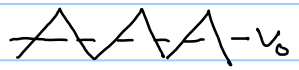
Transient is slow because, no direct feedback from V_o to the comparator.



$D \cdot V_{dd} - I_{Load} \cdot R_{dcr}$

Hybrid Voltage & Current-Mode

V_c  $D \cdot V_{dd}$

V_F  V_o

Controlling Switching Frequency

Current mode

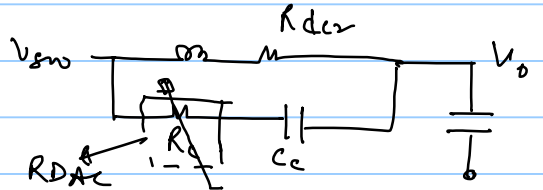
$$F_{sw} = \frac{V_{dd}(1-D)\cdot D}{R_c C_c \Delta V_H}$$

Fix ΔV_H

and F_{sw} can be easily controlled by R_c or C_c

↓

Preferred.



⇒ Fixed Freq. Hysteretic converter

Freq. Locking loop → forces $F_{sw} = F_{ref}$

Voltage mode

$$F_{sw} = \frac{V_{dd}(1-D)D}{L \Delta V_H} \times R_{esr}$$

Very difficult to control F_{sw} due to small ΔV_H