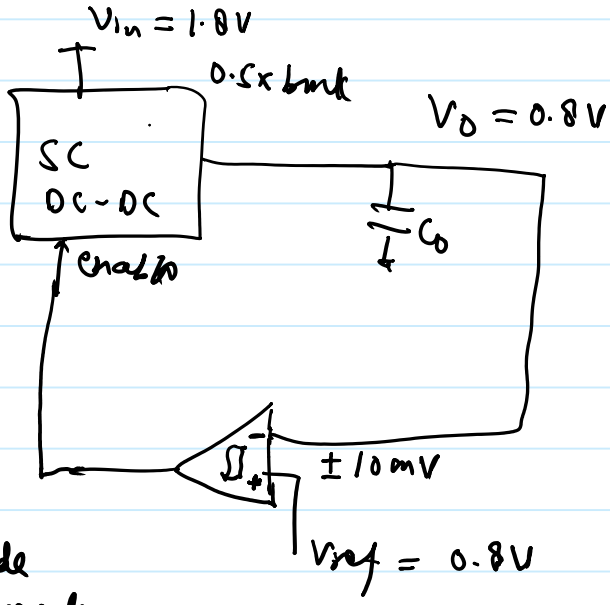
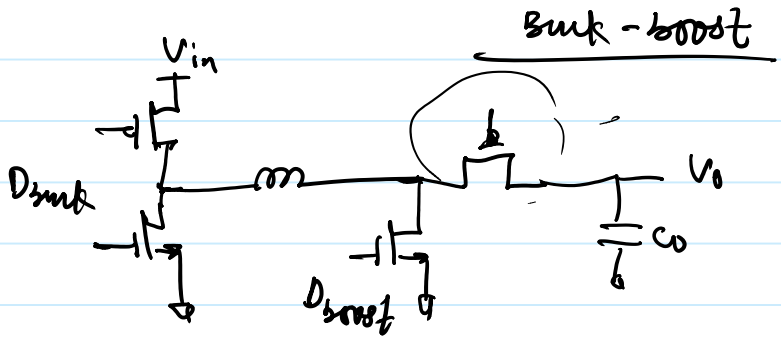
Regulating SC DC-DC using PFM



burst mode
or PFM mode



$$V_0 = \frac{D_{buck}}{1 - D_{boost}} V_{in}$$

$V_0 = 3.3V$

$D_{boost\_max} = ?$

$$V_o = \frac{1}{1-D_{boost}} \cdot V_{in} \Rightarrow 1 - D_{boost} = \frac{V_{in}}{V_o}$$

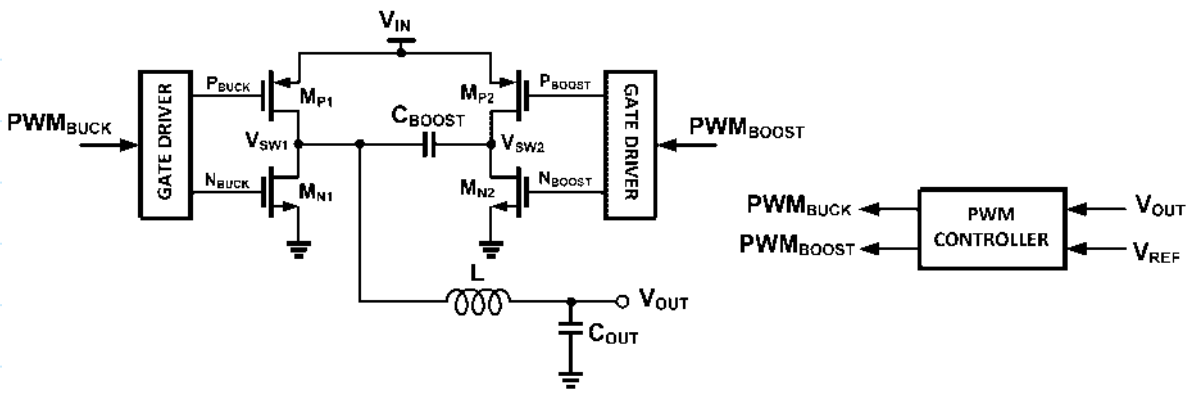
$$\Rightarrow D_{boost} = 1 - \frac{V_{in}}{V_o}$$

$$= 1 - \frac{2.7}{3.3} \approx 0.2$$

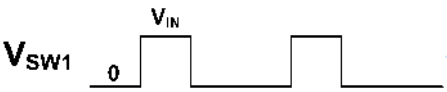
$I_o = 500mA$

D_{boost_max} with losses $\rightarrow 30\%$

$$I_L = \frac{I_o}{1-D_{boost}} = \frac{0.5}{0.7} \approx 0.7A$$



Buck Mode

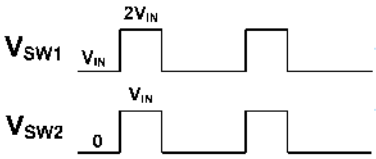


V_{SW2} → Floating (High-Z)

M_{P2}/M_{N2} → OFF
M_{P1}/M_{N1} → PWM

$V_{OUT}=D.V_{IN}$

Boost Mode



M_{P2}/M_{N2} → PWM
M_{P1} → PWM
M_{N1} → OFF

$V_{OUT}=(1+D).V_{IN}$

DC-DC Design Flow

Designing Flow of a DC-DC converter

You are given specifications

V_{in}
V_{out}
I_{load}
η
Accuracy.
Transient.
soft start time
ripple in V_{out}

Example

$V_{in} = 1.8V$, $V_o = 0.8V - 1.5V$

$I_{load} = 0$ to $1A$

$\eta = 90\%$

dc Accuracy $< 1\%$

load transient $\pm 5\%$ with $0 - 1A$ / $1A - 0$

Line transient

$\pm 100mV$ rise/fall $= 100ns$

1. Topology selection
2. Technology
3. Fsw → switching losses
4. L & C