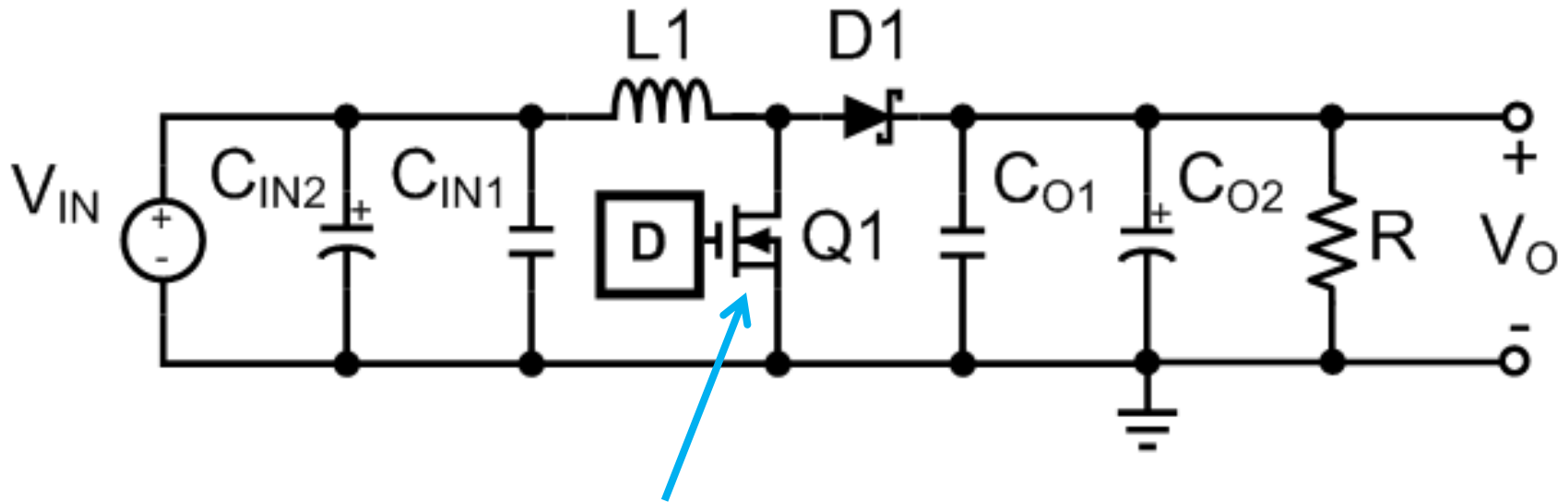


DC-DC Boost Converters



Component Selection and PCB Layout

Schematic for a Generic Boost Converter



Single low-side control FET. Boost controllers and regulators can often be used for flyback, SEPIC, Cuk, Negative Buck, Negative-to-Positive Buckboost and as floating Buck and Buckboost current sources



Duty Cycle Equations

$$D = \frac{V_O + V_D - V_{IN}}{V_O + V_D}$$

$$D_{MAX} = \frac{V_O + V_D - V_{IN-MIN}}{V_O + V_D}$$

$$D_{MIN} = \frac{V_O + V_D - V_{IN-MAX}}{V_O + V_D}$$

NOTE: V_D is the forward voltage of the output diode. Typically 0.5V for Schottky diodes



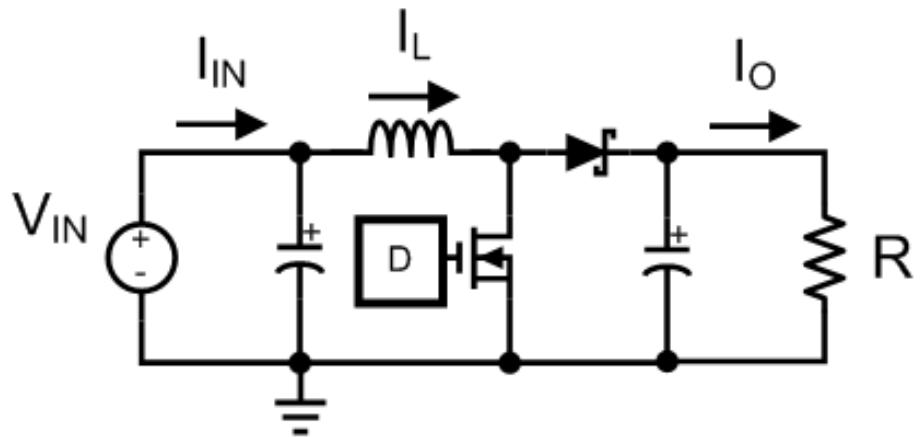
Average Current in the Boost Inductor

- Average input current and average inductor current are equal
- Two basic ways to calculate I_{IN} and I_L :

$$I_L = I_{IN} = \frac{I_o}{(1-D) \times \eta_{EST}}$$

$$I_L = I_{IN} = \frac{I_o \times V_o}{V_{IN} \times \eta_{EST}}$$

HINT: Use 85-90% for η_{EST}



Inductance Selection Equations

1. Select the maximum peak-peak ripple current, $\Delta i_{L(P-P)}$

TIP: 20% to 40% of I_{IN-MAX}

$$L_{MIN1} = D_{MAX} \times \frac{V_{IN-MIN}}{\Delta i_{L(P-P)} \times f_{SW}}$$

2. Check the threshold of DCM:

TIP: To stay in CCM:

$$L_{MIN2} = D_{MIN} \times \frac{V_{IN-MAX}}{2 \times I_{IN-MIN} \times f_{SW}}$$

3. Make $L1 >$ than the higher of L_{MIN1} or L_{MIN2}



Current Ratings for the Inductor

1. DC values for I_{IN-MAX} and I_{O-MAX} are known
2. Calculate actual peak-peak ripple using the selected inductor values

$$\Delta i_{L(P-P)-ACTUAL} = D_{MIN} \times \frac{V_{IN-MAX}}{L1_{ACTUAL} \times f_{SW}}$$

3. Peak inductor current is the sum of the DC value plus one-half of the peak-peak ripple

$$I_{L-PK} = I_{IN-MAX} + \frac{\Delta i_{L(P-P)-ACTUAL}}{2}$$



Peak (Saturation) Current Ratings

Inductance ² (μ H)	Isat (A) ⁵		
	10% drop	20% drop	30% drop
10 \pm 20%	11.7	13.3	14.5
12 \pm 20%	10.6	12.1	13.2
15 \pm 20%	9.50	10.8	11.8
18 \pm 20%	8.70	9.90	10.8
22 \pm 20%	7.90	8.95	9.80

- Inductance drop should be specified – there is no official “IEEE” way to specify saturation current
- I_{SAT} should be higher than the maximum peak current – ***during current limit***



RMS (Self-Heating) Current Ratings

Inductance ² (μH)	I _{rms} (A) ⁶	
	20°C rise	40°C rise
1.0 \pm 20%	6.00	8.00
4.7 \pm 20%	4.50	6.00
5.6 \pm 20%	4.19	5.75
6.8 \pm 20%	3.80	5.20
8.2 \pm 20%	3.55	4.87
10 \pm 20%	3.30	4.20

- I_{RMS} indicates the amount of current which will cause a given temperature rise – typically 40°C
- Select an inductor with an I_{RMS} rating that is higher than the maximum average input current, $I_{\text{IN-MAX}}$

