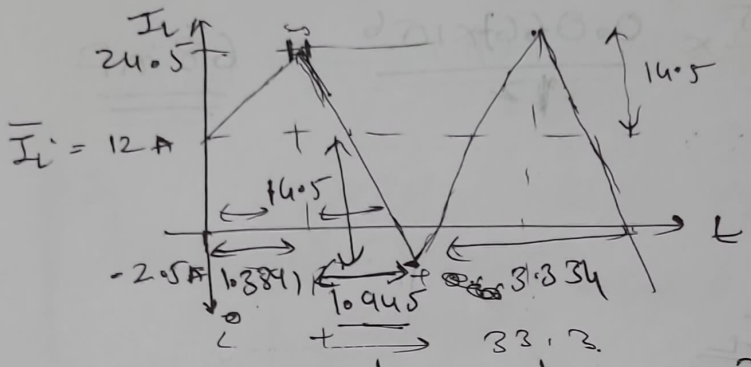
3 Given specs: $V_{in} = 12V$, $V_o = 5V$, $f_{sw} = 300kHz$, $P_{omax} = 60W$, $I_{L\_neg} = 2.5A$, Soft-switching = 2% of T_{sw} Delay time

Design: $\bar{I}_{Lavg} = \frac{P_{omax}}{V_o} = \frac{60}{5} = 12A$

∴ graph will be



$\therefore I_{Lmax} = 12 + 14.05 = 24.05A$

Time period = $T_{sw} = \frac{1}{f_{sw}} = \frac{1}{300kHz} = 3.334\mu s$

Duty cycle = $\frac{V_o}{V_{in}} = \frac{5}{12} = 0.416 \Rightarrow 41.6\%$

$\therefore T_{ON} = 41.6\%$ of $T_{sw} = 1.3891\mu s$

$\therefore T_{OFF} = 1.945\mu s$

$\therefore L_{max} = \frac{V}{dI/dt} = \frac{V_{in} - V_o}{\frac{dI}{dt}}$

$\frac{dI}{dt}$ → slope of the graph = $\frac{-2.05 - 24.05}{(3.334 - 1.389)\times10^{-6}}$

$= \frac{-27}{1.945} = -13.8881 \times 10^6 A/s$

$L_{max} = 0.3601\mu H$

$C\frac{dV}{dt} = \frac{I_L}{2}$

Capacitance current = $\frac{I_L}{2}$

for the peak value,

$I_L = 24.05A$,

$\frac{dV}{dt} = \frac{12-0}{T_{ON}} = \frac{12-0}{1.391\times10^{-6}} = 8.626 V/\mu s$

$\therefore C = \frac{I_L}{2} \times \frac{1}{dV/dt} = 0.1052nF$

Soft switching delay time = 2% of T_{sw}

$$= \frac{2 \times 3.334 \times 10^{-6}}{100}$$

$$= 0.0667 \times 10^{-6}$$

(a) +ve I_{peak}

$$\therefore C\frac{dV}{dt} = \frac{I_L}{2}$$

$$\Rightarrow C = \frac{24.5}{2} \times \frac{0.0667 \times 10^{-6}}{12} \approx 68\ nF$$

(a) -ve I_{peak}

$$C\frac{dV}{dt} = \frac{I_L}{2}$$

$$\Rightarrow C = \frac{2.5}{2} \times \frac{0.0667 \times 10^{-6}}{12} = 6.947\ nF$$

∴ Taking lowest capacitor value

$$C = 6.947\ nF$$

Based on simulation $R = 1\Omega$

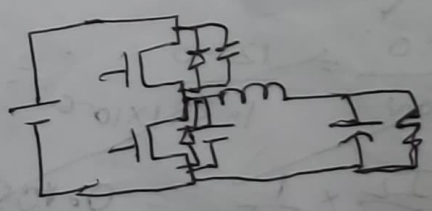
$$R_{Load} = \frac{V_o}{I_L} = \frac{5}{12} = 0.416\Omega$$

$$C_{Load} = \frac{I_{Lavg} \times dt}{dV_o} = \frac{12 \times 3.334 \times 10^{-6}}{100 \times 10^{-3}} = 400\mu F$$

(taking ripple as 100mV)

∴ Design values:

L_m	$0.3061\ \mu H$
C	$6.947\ nF$
C_{load}	$400\mu F$
R_{load}	1Ω



Input pulse for soft switching

S1: $T = 3.334\ \mu s$, $d = 39.66\%$

S2: $T = 3.334$, $d = 56.33\%$

delay = $1.338\ \mu s$