| Step | PARAMETERS/EQUATIONS | |
|---|---|---|
| 1: Inputs | Pick $V_{in}, V_{out}$,and $f_{osc}$to calculate equations below. | $V_{in} = 18\ V$<br>$V_{out} = -15\ V$<br>$f_{osc} = 1\ MHz\ (< f_{max} = 2.5MHz)$ |
| 2: DC | $DC \cong \frac{\lvert V_{OUT}\rvert + 0.5V}{V_{IN} + \lvert V_{OUT}\rvert + 0.5V - 0.27V}$ | $DC \cong \frac{\lvert -15\rvert + 0.5}{18 + \lvert -15\rvert + 0.5 - 0.27} = 46.6\%$ |
| 3: L | $L_{TYP} = \frac{(V_{IN} - 0.27V)\cdot DC}{f_{OSC}\cdot 1.8A}$<br>$L_{MIN} = \frac{(V_{IN} - 0.27V)\cdot(2DC - 1)}{4A\cdot f_{OSC}\cdot(1 - DC)}$<br>$L_{MAX} = \frac{(V_{IN} - 0.27V)\cdot DC}{f_{OSC}\cdot 0.5A}$ | $L_{TYP} = \frac{(18 - 0.27)\cdot 0.466}{1\cdot 10^6\cdot 1.8} = 4.59\ \mu H$<br>$L_{MIN} = \frac{(18 - 0.27)\cdot(2\cdot 0.466 - 1)}{4\cdot 1\cdot 10^6\cdot(1 - 0.466)} = -564\ nH \rightarrow 564\ nH$<br>$L_{MAX} = \frac{(18 - 0.27)\cdot 0.466}{1\cdot 10^6\cdot 0.5} = 16.5\ \mu H$ |
| 4: $I_{RIPPLE}$ | $I_{RIPPLE} = \frac{(V_{IN} - 0.27)\cdot DC}{f_{OSC}\cdot L}$ | $I_{RIPPLE} = \frac{(18 - 0.27)\cdot 0.466}{1\cdot 10^6\cdot 4\cdot 10^{-6}} = 2.066\ A$ |
| 5: $I_{OUT}$ | $I_{OUT} = \left(6A - \frac{I_{RIPPLE}}{2}\right)\cdot(1 - DC)$ | $I_{OUT} = \left(6 - \frac{2.066}{2}\right)\cdot(1 - 0.466) = 2.652\ A$ |
| 6: $D_1$ | $V_R > V_{IN} + \lvert V_{OUT}\rvert; I_{AVG} > I_{OUT}$ | $V_R > 18 + \lvert -15\rvert \rightarrow V_R > 33\ V$<br>$I_{AVG} > I_{OUT} \rightarrow ???$ |
| 7: $C_1$ | $4.7\ \mu F\ (typical); V_{RATING} > V_{IN} + \lvert V_{OUT}\rvert$ | $C_1 = 4.7\ \mu F$<br>$V_{RATING} > 18 + \lvert -15\rvert \rightarrow V_{RATING} > 33\ V$ |
| 8: $C_{OUT}$ | $C_{OUT} = \frac{I_{RIPPLE}}{8\cdot f_{OSC}\cdot 5\cdot 10^{-3}\cdot \lvert V_{OUT}\rvert}$ | $C_{OUT} = \frac{2.066}{8\cdot 1\cdot 10^6\cdot 5\cdot 10^{-3}\cdot \lvert -15\rvert} = 3.443\ \mu F$ |
| 9: $C_{IN}$ | $C_{IN} = C_{PWR} + C_{VIN}$<br>$C_{IN} = \frac{I_{RIPPLE}}{8\cdot f_{OSC}\cdot 5\cdot 10^{-3}\cdot V_{IN}} + \frac{6A\cdot DC}{40\cdot f_{OSC}\cdot 5\cdot 10^{-3}\cdot V_{IN}}$ | $C_{IN} = \frac{2.066}{8\cdot 1\cdot 10^6\cdot 5\cdot 10^{-3}\cdot 18} + \frac{6\cdot 0.466}{40\cdot 1\cdot 10^6\cdot 5\cdot 10^{-3}\cdot 18} = 3.646\ \mu F$ |
| 10: $R_{FB}$ | $R_{FB} = \frac{\lvert V_{OUT}\rvert + 9mV}{83.3\mu A}$ | $R_{FB} = \frac{\lvert -15\rvert + 9\cdot 10^{-3}}{83.3\cdot 10^{-6}} = 180.180\ k\Omega \rightarrow 180\ k\Omega$ |
| 11: $R_T$ | $R_T = \frac{87.6}{f_{OSC}} - 1; f_{OSC}\ in\ MHz\ and\ R_T\ in\ k\Omega$ | $R_T = \frac{87.6}{1} - 1 = 86.6\ k\Omega \rightarrow 82\ k\Omega$ |