LT8642S_1_A Power Design

Parameters

$Vin_{nom} := 13.2\ V$ $Vout_{nom} := 5\ V$ $I_{out\_min} := 0\ A$

$Vin_{min} := 10\ V$ $Vout_{max} := Vout_{nom} \cdot 1.05 = 5.25\ V$ $I_{out\_max} := 8\ A$

$Vin_{max} := 15\ V$ $Vout_{min} := Vout_{nom} \cdot 0.95 = 4.75\ V$ $F_{sw} := 1.6\ MHz$

$Vp_{max} := \left(Vout_{max} - Vout_{nom}\right) \cdot 0.25 = 0.063\ V$

FB Resistor Calcs

$R_{bot} := 6.8$

$R_{top\_calc} := R_{bot} \cdot \left(\frac{Vout_{nom}}{0.597} - 1\ V\right) = 50.151\ V$ Need to fix units. 50kOhms

Switching Frequency

Set Fsw

$$Rt := \left(\frac{46.5}{\left(F_{sw}\right) \cdot 10^{-6}} - 1\ s\right) = 28.063\ s$$

Fsw OK?

Datasheet Values

$V_{sw\_top} := 0.2\ V$ $V_{sw\_bot} := 0.1\ V$ $t_{on\_min} := 35\ ns$

$$F_{sw\_max\_allowable} := \frac{\left(Vout_{nom} + V_{sw\_bot}\right)}{t_{on\_min} \cdot \left(Vin_{nom} - V_{sw\_top} + V_{sw\_bot}\right)} = \left(1.112 \cdot 10^{7}\right)\ \frac{1}{s}$$

$F_{sw\_max\_allowable} > F_{sw} = 1$

$$Vin_{min\_allowable} := \frac{\left(Vout_{nom} + V_{sw\_bot}\right)}{1 - F_{sw} \cdot t_{on\_min}} - V_{sw\_bot} + V_{sw\_top} = 5.503\ V$$

$Vin_{min\_allowable} < Vin_{min} = 1$

Inductor Calculations

$$L_{initial} := \left(\frac{Vout_{nom} + V_{sw\_bot}}{F_{sw}}\right) \cdot 0.5 = \left(1.594 \cdot 10^{-6}\right)\ Wb$$

$$\Delta I_L := \frac{Vout_{nom}}{L_{initial} \cdot F_{sw}} \cdot \left(1 - \frac{Vout_{nom}}{Vin_{max}}\right) = 1.307$$

$$I_{load\_max\_min} := 13.5$$

$$I_{load\_max\_max} := 18$$

$$I_{L\_peak\_1} := I_{load\_max\_min} + 0.5 \cdot \Delta I_L = 14.154$$

$$I_{L\_peak\_2} := I_{load\_max\_max} + 0.5 \cdot \Delta I_L = 18.654$$

Input Caps

$\eta := 0.9$ Estimated efficiency

$$D_{max} := \frac{Vout_{nom}}{Vin_{max} \cdot \eta} = 0.37$$

$$Cin_{min} := \frac{I_{out\_max} \cdot D_{max} \cdot (1 - D_{max}) \cdot 1000 \cdot 1000}{F_{sw} \cdot Vp_{max}} = 18.656\ F$$

Extra 1000 is to convert MHz to KHz from Fsw

See http://www.ti.com/lit/an/slta055/slta055.pdf equation 1, 9

$$Cin_{bulk} := \frac{1.21 \cdot I_{out\_max} \cdot I_{out\_max} \cdot L_{initial}}{Vp_{max} \cdot Vp_{max}} = 0.032\ \frac{s^4 \cdot A^3}{kg \cdot m^2}$$

Adjusting for units: 320uF

Design note: Vin should be bypassed with at least 3 ceramic caps: Two small 0402 or 0603 <1uF caps on either side and a larger 4.7uF cap (X7R)

Output Caps