

# LT8642S\_1\_A Power Design

## Parameters

$$V_{in_{nom}} := 13.2 \text{ V}$$

$$V_{out_{nom}} := 5 \text{ V}$$

$$I_{out_{min}} := 0 \text{ A}$$

$$V_{in_{min}} := 10 \text{ V}$$

$$V_{out_{max}} := V_{out_{nom}} \cdot 1.05 = 5.25 \text{ V}$$

$$I_{out_{max}} := 8 \text{ A}$$

$$V_{in_{max}} := 15 \text{ V}$$

$$V_{out_{min}} := V_{out_{nom}} \cdot 0.95 = 4.75 \text{ V}$$

$$F_{sw} := 1.6 \text{ MHz}$$

$$V_{p_{max}} := (V_{out_{max}} - V_{out_{nom}}) \cdot 0.25 = 0.063 \text{ V}$$

## FB Resistor Calcs

$$R_{bot} := 6.8$$

$$R_{top\_calc} := R_{bot} \cdot \left( \frac{V_{out_{nom}}}{0.597} - 1 \right) = 50.151 \text{ V}$$

Need to fix units. 50kOhms

## Switching Frequency

Set Fsw

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

Fsw OK?

Datasheet Values

$$V_{sw\_top} := 0.2 \text{ V}$$

$$V_{sw\_bot} := 0.1 \text{ V}$$

$$t_{on\_min} := 35 \text{ ns}$$

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

$$V_{in_{min\_allowable}} := \frac{F_{sw\_max\_allowable} \cdot (V_{out_{nom}} + V_{sw\_bot})}{1 - F_{sw} \cdot t_{on\_min}} - V_{sw\_bot} + V_{sw\_top} = 5.503 \text{ V}$$

$$V_{in_{min\_allowable}} < V_{in_{min}} = 1$$

## Inductor Calculations

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

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

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

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

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

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

## Input Caps

$$\eta := 0.9$$

Estimated efficiency

$$D_{max} := \frac{V_{out_{nom}}}{V_{in_{max}} \cdot \eta} = 0.37$$

$$C_{in_{min}} := \frac{I_{out_{max}} \cdot D_{max} \cdot (1 - D_{max}) \cdot 1000 \cdot 1000}{F_{sw} \cdot V_{p_{max}}} = 18.656 \text{ } \mathbf{F}$$

Extra 1000 is to convert  
MHz to KHz from Fsw

See <http://www.ti.com/lit/an/slt055/slt055.pdf>  
equation 1, 9

$$C_{in_{bulk}} := \frac{1.21 \cdot I_{out_{max}} \cdot I_{out_{max}} \cdot L_{initial}}{V_{p_{max}} \cdot V_{p_{max}}} = 0.032 \frac{\mathbf{s^4 \cdot A^3}}{\mathbf{kg \cdot m^2}}$$

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)

[ 2 ]

[ 0 ]

$$N_{Cin} := \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} \quad C_{in} := \begin{bmatrix} \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{in\_esr} := \begin{bmatrix} 0 \\ \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{in\_esl} := \begin{bmatrix} 0 \\ \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{in\_total}$$

$$C_{in\_esr\_total}$$

$$C_{in\_esl\_total}$$

## Output Caps

$$N_{Cout\_cer} := \begin{bmatrix} 2 \\ 2 \\ 1 \\ 1 \end{bmatrix} \quad C_{out\_cer} := \begin{bmatrix} 0 \\ \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{out\_cer\_esr} := \begin{bmatrix} 0 \\ \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{out\_cer\_esl} := \begin{bmatrix} 0 \\ \text{ } \\ \text{ } \\ \text{ } \end{bmatrix}$$

$$C_{out\_cer\_total}$$

$$C_{out\_cer\_esr\_total}$$

$$C_{in\_cer\_esl\_total}$$

$$N_{Cout\_tan} := [2] \quad C_{out\_tan} := [0]$$

$$C_{out\_tan\_esr} := [0]$$

$$C_{out\_tan\_esl} := [0]$$

$$C_{out\_tan\_total}$$

$$C_{out\_tan\_esr\_total}$$

$$C_{in\_tan\_esl\_total}$$

