

EE394J11 Homework Assignment #4

Due date: 11/13/2013

For all questions elaborate some few conclusions or comments about the results. For all questions with simulations include a graph with the used model. State all the assumptions made in your solutions of the problems.

- 1) Consider an IRFPS3810 MOSFET operating with an unclamped load of $R = 1.25 \Omega$. The switching frequency is 50 kHz, $V_{DD} = 50 \text{ V}$, and the duty cycle is 0.6. Also, assume that T_J should stay below 100 C. What is the minimum length of the heatsink if it is used a model 63730 from Aavid Thermalloy (<http://www.aavidthermalloy.com>)? You may approximate the switching losses by considering the total switching time calculated from the times given in the MOSFET datasheet (although these times may not lead to an exact calculation because the load is different). Consider also that the ambient temperature is 25C.
- 2) Search the Internet for the Military Handbook 217. Calculate the failure rate of the MOSFET in problem #1 under the same conditions indicated in problem #1 and when the circuit is operating in a rectifier with natural convection inside an outside cabinet during a summer day. You can assume that in this second case the ambient temperature is about 55C. Do the assumptions you consider necessary in order to calculate the necessary reliability adjusting factors. Tip: MOSFETs are discussed in Section 6.4 of this standard.
- 3) Wikipedia (http://en.wikipedia.org/wiki/Failures_in_time) says that “The relationship of FIT to MTBF may be expressed as: $MTBF = 1,000,000,000 \times 1/FIT$.” Is this statement strictly correct? Why or why not? Please write a couple of paragraphs discussing potential issues in this Wikipedia page.
- 4) Find the ECCE 2011 paper entitled “Modeling of Multiple-Input DC-DC Converters Considering Input-Coupling Effects” by Zhao, Yu and Kwasinski, and reproduce the results in Table II for the 3 models under evaluation (SSA, RMF and MF) but for a switching frequency of 25 kHz and 100 kHz. For your analysis use the same circuit parameters discussed in the paper.