Matthew Spencer – Fall 2020

E157 Design Project 1: Filter

Design a ladder filter that could be implemented on the stock filter PCBs. The ladder filter should be a lowpass which meets the following specifications:

- Pass band edge of 100MHz
- Stop band start of 200MHz
- 20dB of rejection in the stop band
- Insertion loss of less than 3dB
- In-band ripple of less than 1dB

Simulate your filter using ltSpice, and report its performance using Smith Charts, phase plots and magnitude plots for S11 and S21. Calculate the power delivered to your load resistor and verify it with simulation. Theory and simulation need to match in your design, so be sure to comment on the comparison between your calculations and your simulated behavior.

In addition to simulating an ideal filter, we are going to try to capture the effect of many possible non-idealities. Add parasitics to your simulation to represent the board used to make your filter, paying special attention to the effect of vias. Also, select a set of components to use for your filter by searching online: you'll need 0805 surface mount inductors, capacitors and resistors. Look up ESL and ESR values for the components you're going to use, and include those in your simulation. Finally, introduce appropriate component variation into your filter by looking up the tolerance of your components and varying the elements of your simulation using either Monte-Carlo techniques or a worst case analysis. Ensure that your filter meets specifications even with component variations and real-world parasitics.

Helpful References:

https://www.analog.com/en/technical-articles/ltspice-worst-case-circuit-analysis-with-minimal-simulations-runs.html

http://k6jca.blogspot.com/2012/07/monte-carlo-and-worst-case-circuit.html