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"I completed this homework assignment independently."

Question 1)

The center frequency is chosen as 70MHz and the bandwith of the filter is chosen as 7MHz. The calculations made for the filter design can be seen at the Appendix.

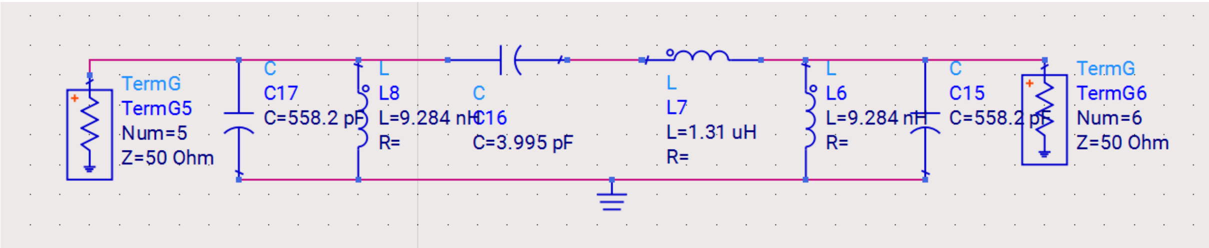


Fig. 1: Designed third order Chebyshev Bandpass filter

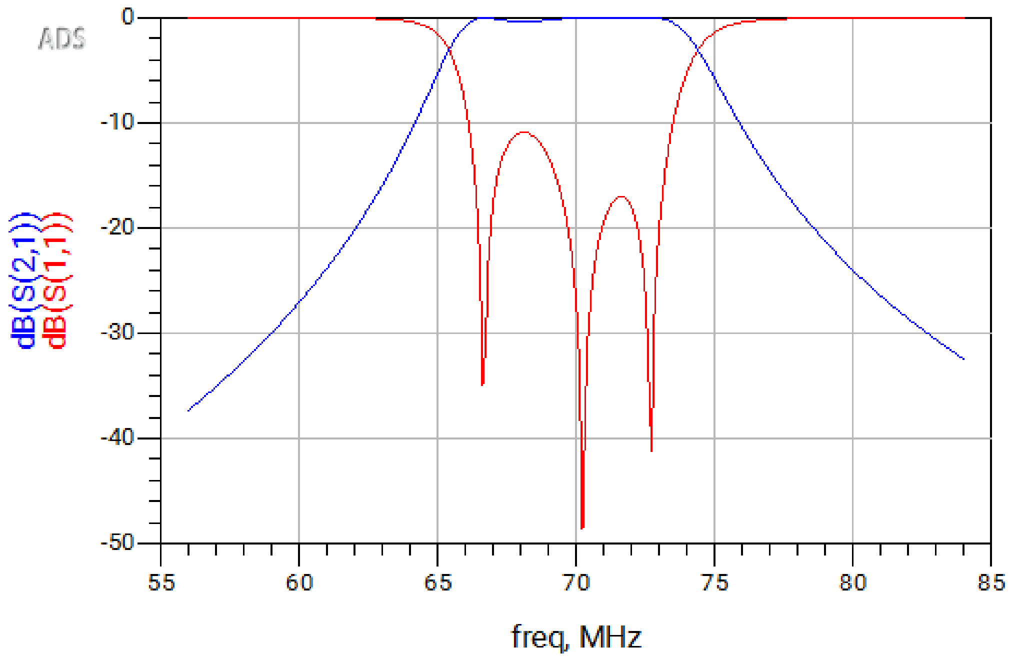


Fig. 2: S11 and S21 dB plot for part a)

As seen from Fig. 2, S11 is less than -12dB and S21 is -0.1, as measured from ADS simulation, which satisfies the conditions.

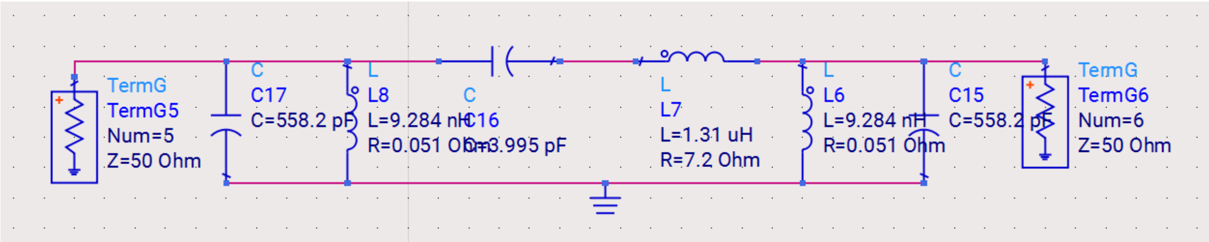


Fig. 1: Q factor for inductors are inserted

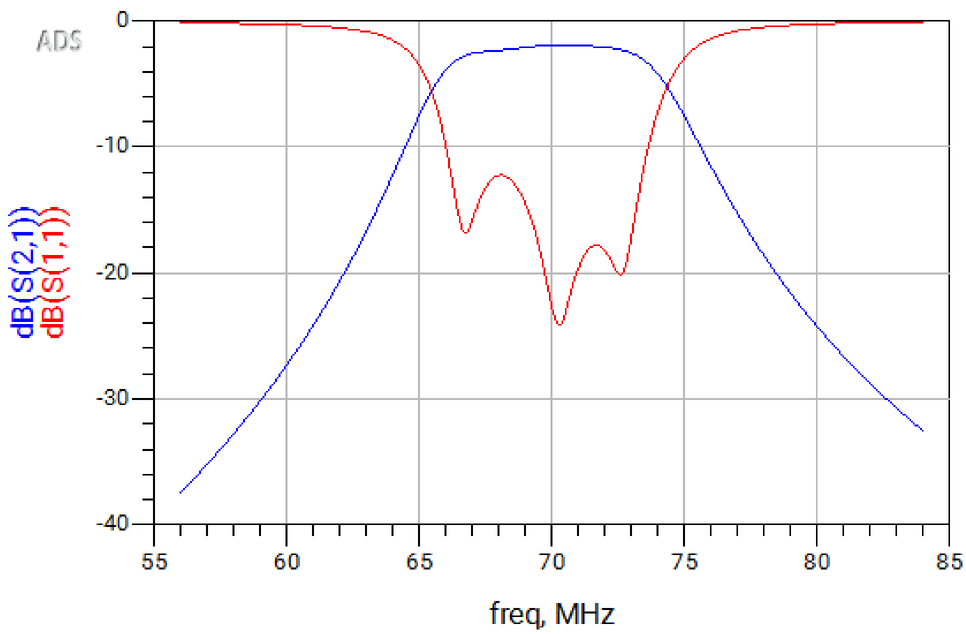


Fig. 2: S11 and S21 dB plot when inductors have Q=80, part b)

For inserting Q factor, I used the following formula:

$$Q = \frac{2\pi f L}{R}$$

From this formula, I calculated R values and inserted that into the simulation. The dB gains are changed after Q factor insertion.

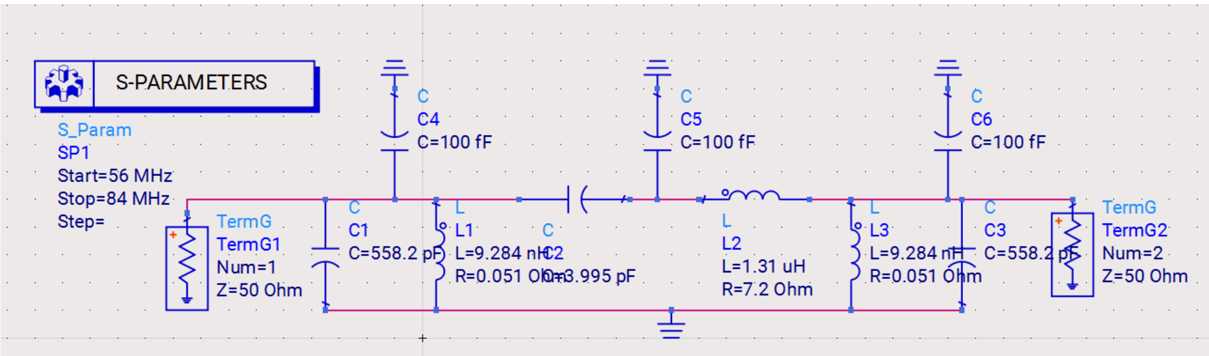


Fig. 3: 100fF parasitic capacitors are added to the circuit

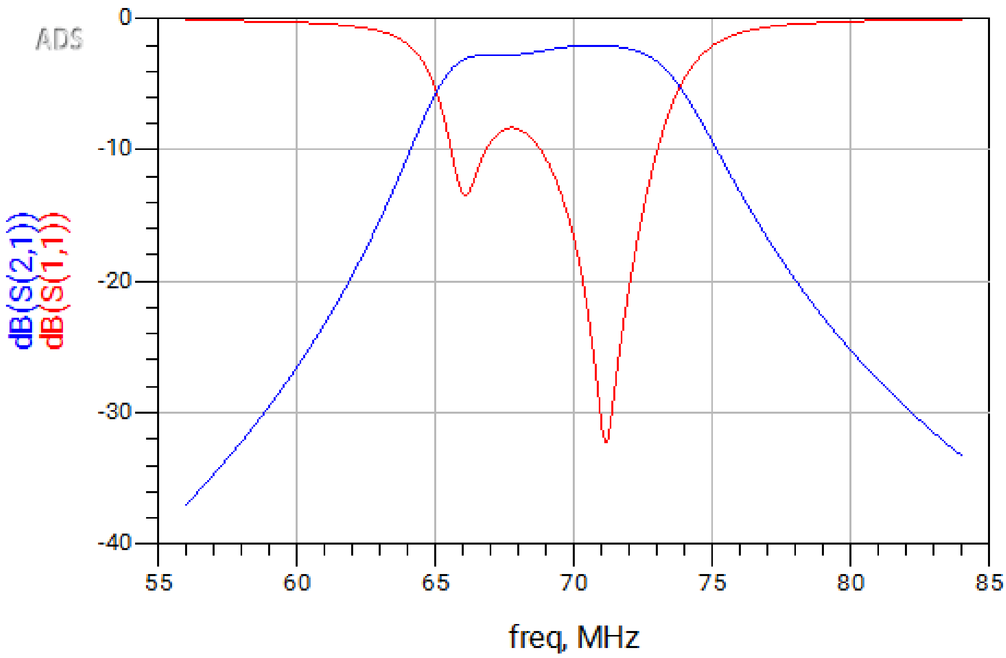


Fig. 4: When 100fF parasitic capacitors are added and degradation is observed, part c)

As seen from Fig. 6, after adding 100fF parasitic capacitors, the dB response is degraded more. This degradation is caused because of the inevitable feedback (proximity), therefore it results in a oscillation in high frequency.

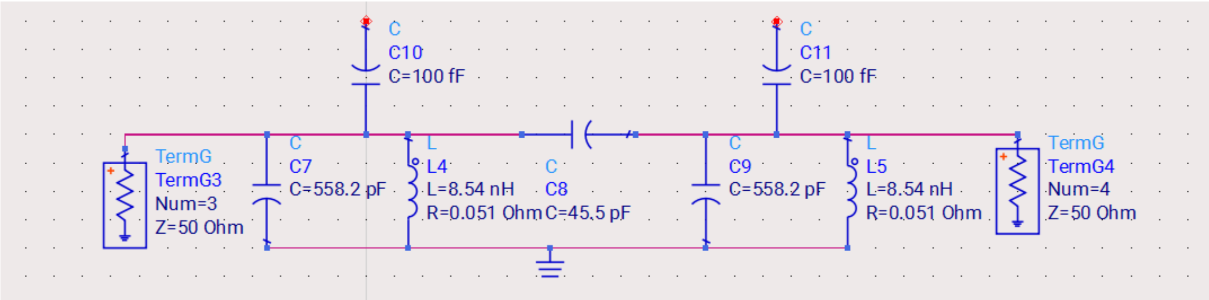


Fig. 6: Filter with no series LC branches

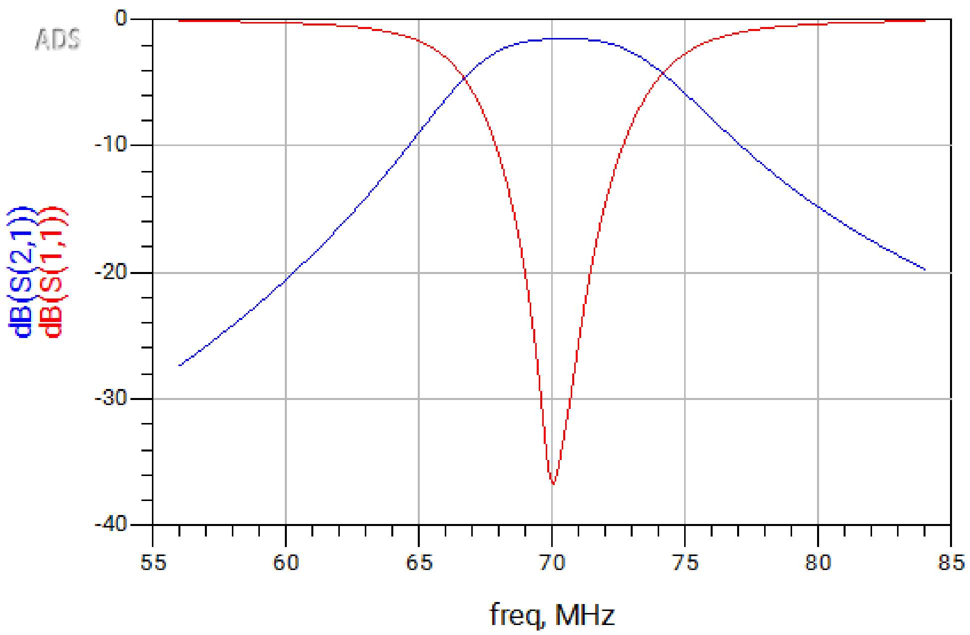


Fig. 5: Filter with no series LC branch, part d)

As seen from Fig. 8, there is a single spike for S11, whereas in the first topology there are 3, one at the center frequency and one for both upper and lower cutoff frequencies.

Question 2)

Calculations for this part can be seen at the Appendix

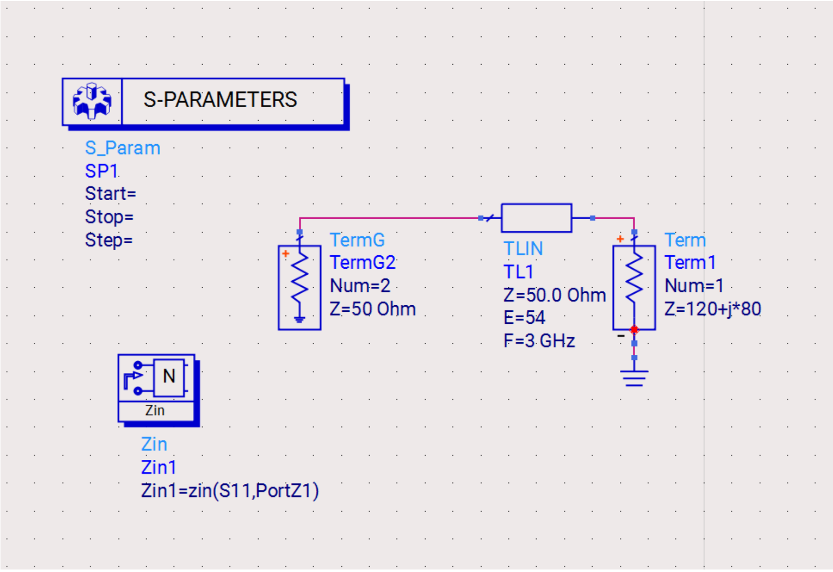


Fig. 7: Schematic of the transmission line circuit

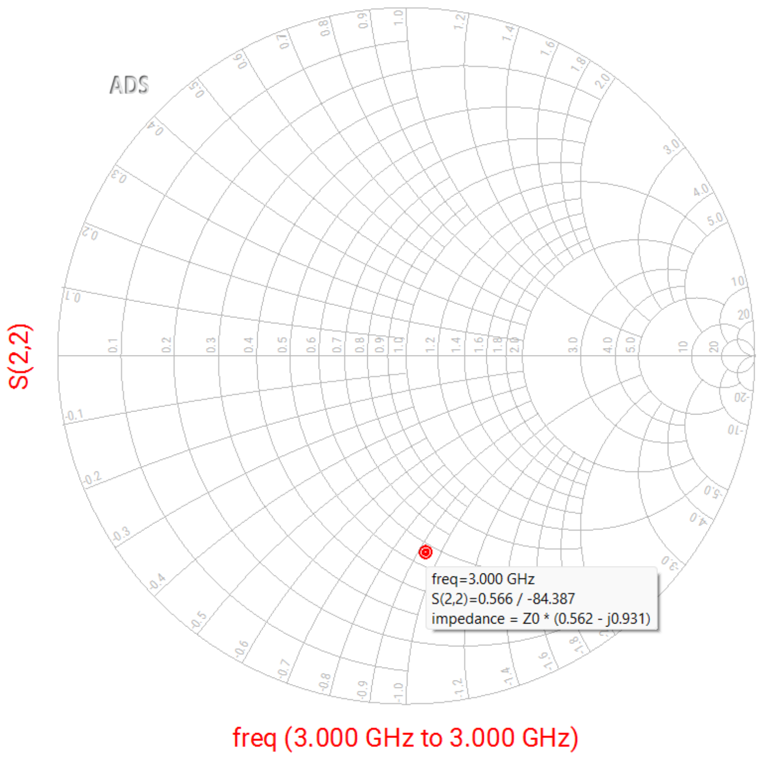
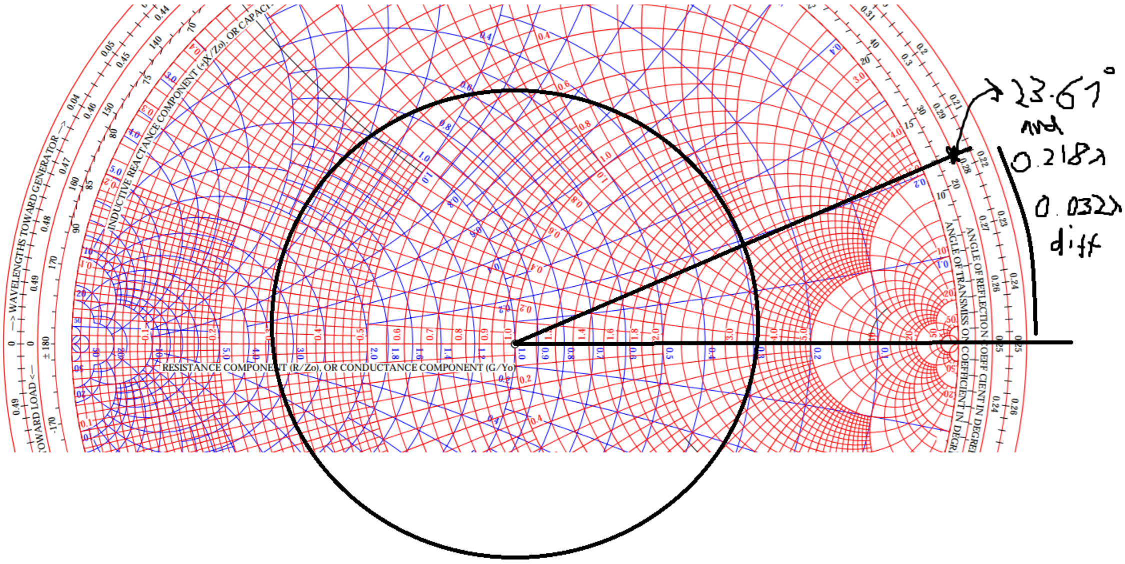


Fig. 8: Verification of the input impedance using ADS simulation

By hand calculation, input impedance is calculated as 0.562 – j0.92. After that, this result is verified by using a Smith chart. Then, the circuit is simulated in ADS and the value above is measured, which is 50 * (0.562 – j0.931). The results are nearly same, which shows that the results are correct.



Using the Smith chart and VSWR, I found the corresponding degree and length, then I find the difference to have purely real impedance. The result is found as 12 degrees which is 0.033λ.

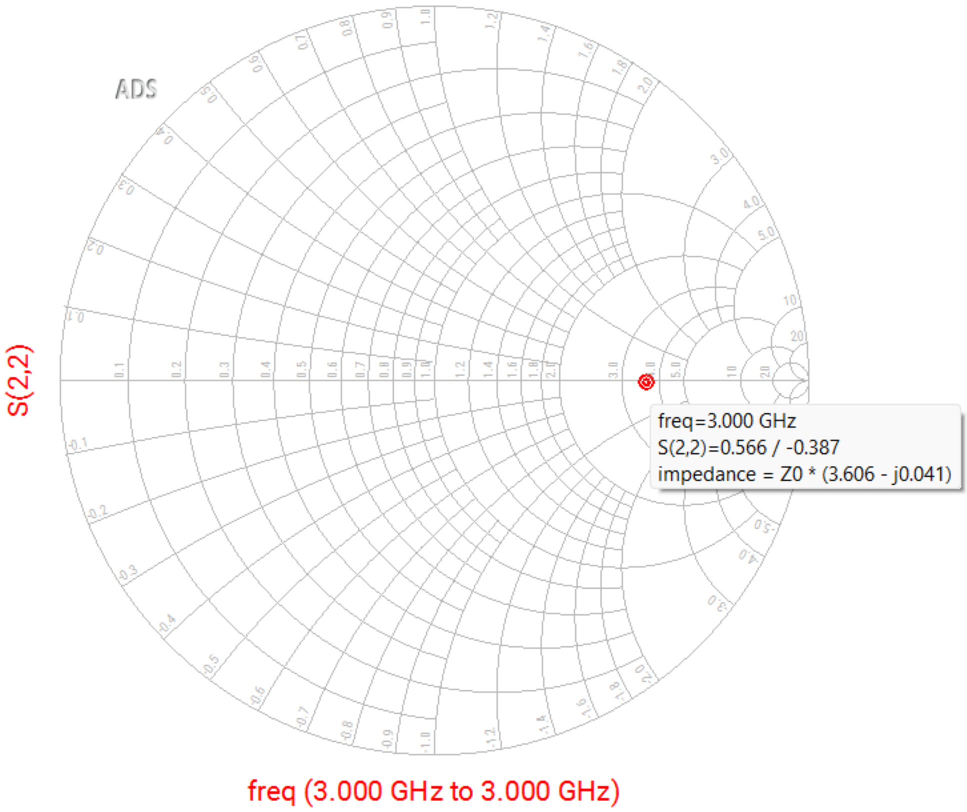


Fig. 9: Purely real impedance with different transmission line length