Report of the Second Project for EE172

Three Order LC Bandpass Filter

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1-Introduction:

As a group of the second project, our group has to design the three order bandpass filter that meets the requirement of the center frequency at 915 Mhz, 20% bandpass at 40dB, and 0.5 dB equal ripple.

2-Theoretical:

According to the table 8.4 in Microwave Engineer book, we can find values of L and C components for N=3:

G1=1.5963; G2=1.0967; G3=1.5963, and G4=1.0

We also calculate the L, C components of the bandpass filter by formulas:

- For odd capacitors and inductors:

  $C_{odd}=\Delta/(\omega G_{odd})$ $L_{odd}=G_{odd}/(\omega\Delta)$

- For even capacitors and inductors:

  $C_{(even)}=G_{(even)}/(\omega\Delta)$ $L_{(even)}= \Delta/(\omega G_{(even)})$

3-Calculation values

By using above formulas we have capacitors, inductors values:

C1=0.436pf L1=69.4nH

C2=19.076pf L2=1.586nH

C3=0.436pf L3=69.4nH

And three order circuit and waveform of the bandpass filter like figures below:

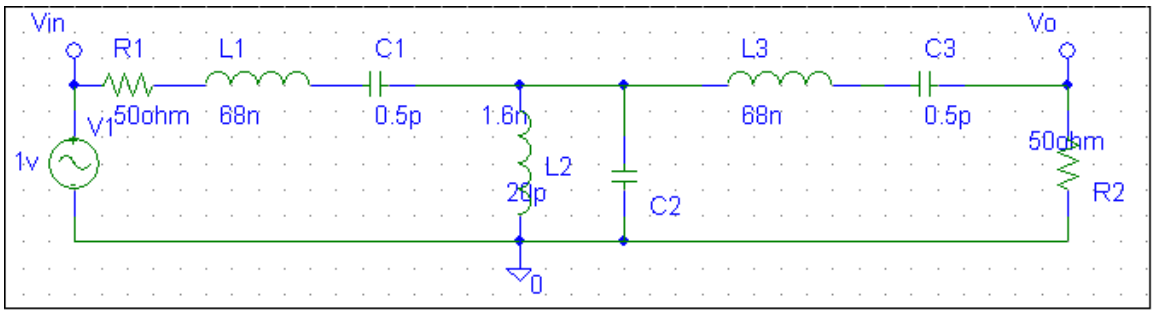

Fig. 1 The circuit of three order bandpass by calculating values

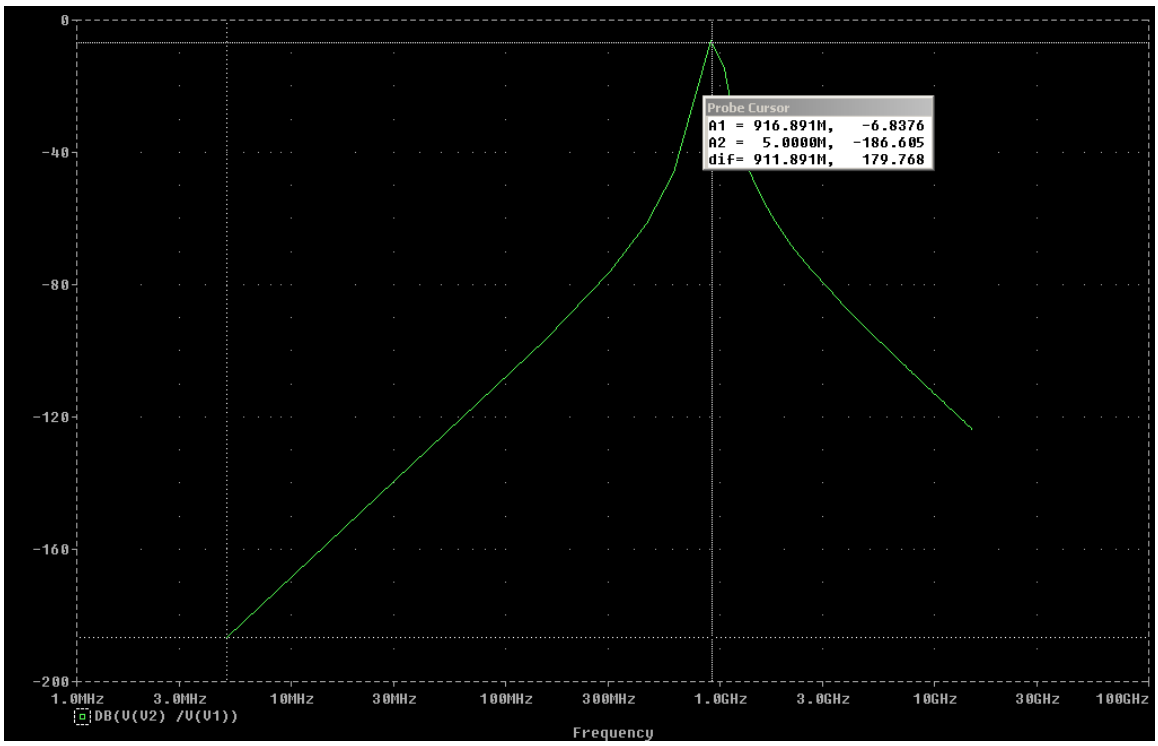

Fig.2 The Pspice waveform of three order bandpass filter by calculating values

From the waveform, we can see that the bandpass filter meets the center frequency at 916Mhz. However, it is hard to find the exact component values, so we only find the best match components for our design.

C1=0.5pf L1=68nH

C2=206pf L2=1.6nH

C3=0.5pf L3=68nH

By using the Pspice simulation, we can have the waveform of the bandpass filter for the real component values looks like the fig. 3

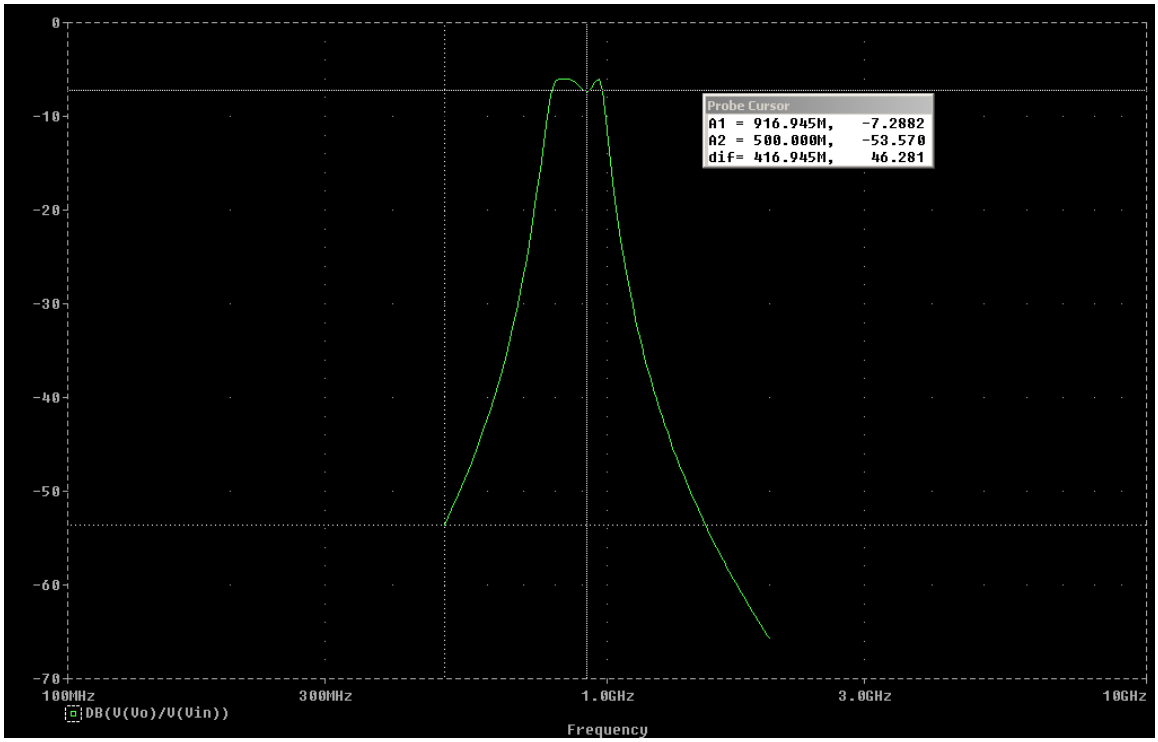

Fig. 3 The waveform of three order bandpass filter by real components

4-Testing and Analysis:

By using the network analysis to check the bandpass filter, we get the center frequency at 1GHz, and the bandwidth at 60dB. The result has a lot different with the

expectation values because we cannot find the exact values of components, and the affect of the transmission lines and soldering in the circuit will also change the final result.

5-Facing difficult problems:

There were so many problems we encountered. First, the bandpass filter was assigned for four people to do it, but we only have three to do so. Second, We also met the problem that we could not find the exact component values we needed. We had tried many stores to buy the best match values of our design components. Another problem that the copper tape was sold out when we had tried to buy in different stores. However, we got lucky that we got help to have the copper tape from other group member when we posted the helping message on the yahoo group. Finally, we got the final testing result on Friday with center frequency at 1Ghz. By the formulas of capacitors and inductors, we can see that the L and C are invert proportional to the center frequency, so we can fix this problem by increasing the capacitors and inductors by 10% to pull the center frequency down to 915 Mhz. However, within the time limitation, we had to stop with this result even though it did not perfectly meet our requirement.

6-Conclusion:

By doing this project, we can learn a lot about how to build the bandpass filter, to use network analysis to test the radio frequency signal. We also learn that the transmission line in the circuit can change capacitor and inductor values of the circuit that can affect to our final result.