Homework 4

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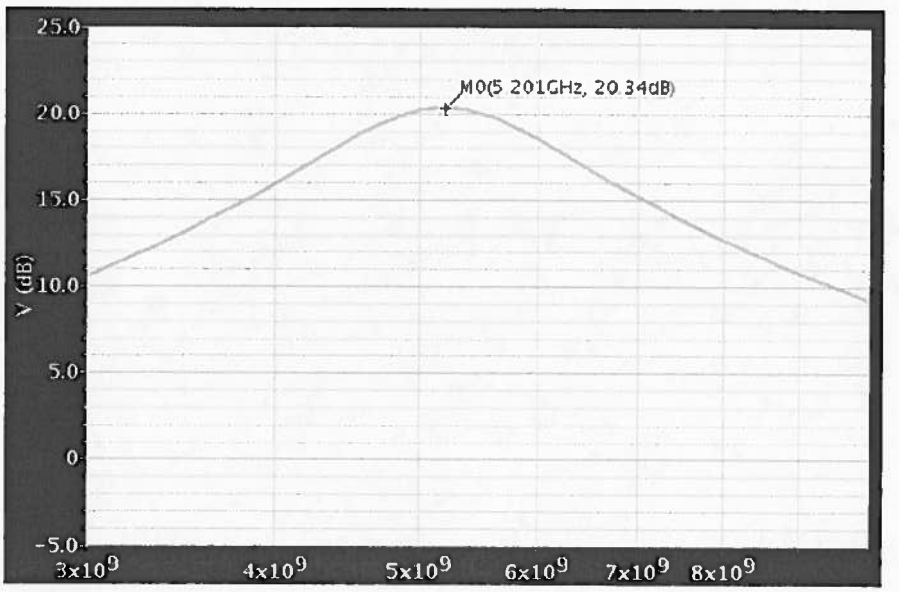
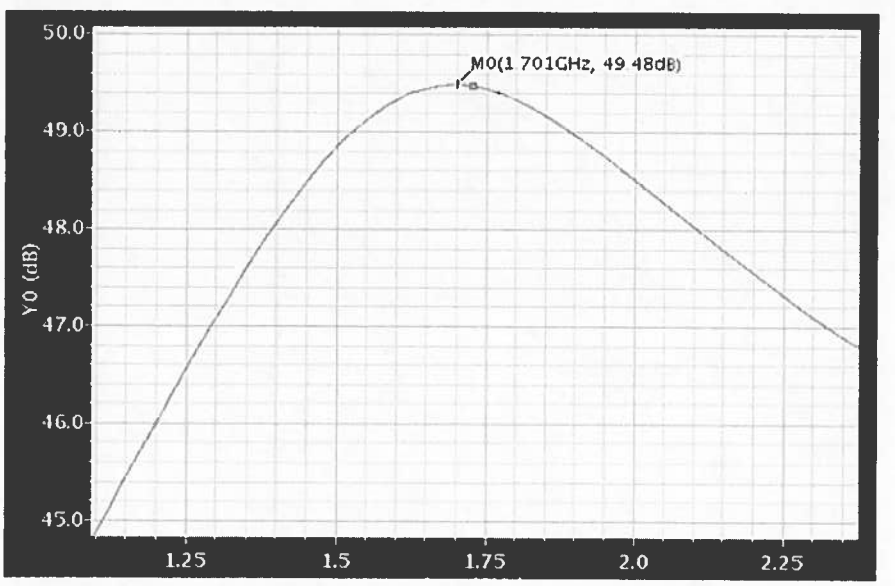
a) In order to resonate at 5.2 GHz, L1=5.1 nH. The gain of LNA is 20.34 dB, as plotted below:




In order to find L2, first all AC input to mixer is shorted to AC ground, and then a port is put at the output of RF mixer and Z parameter vs. frequency is simulated. When

L2=22 nH

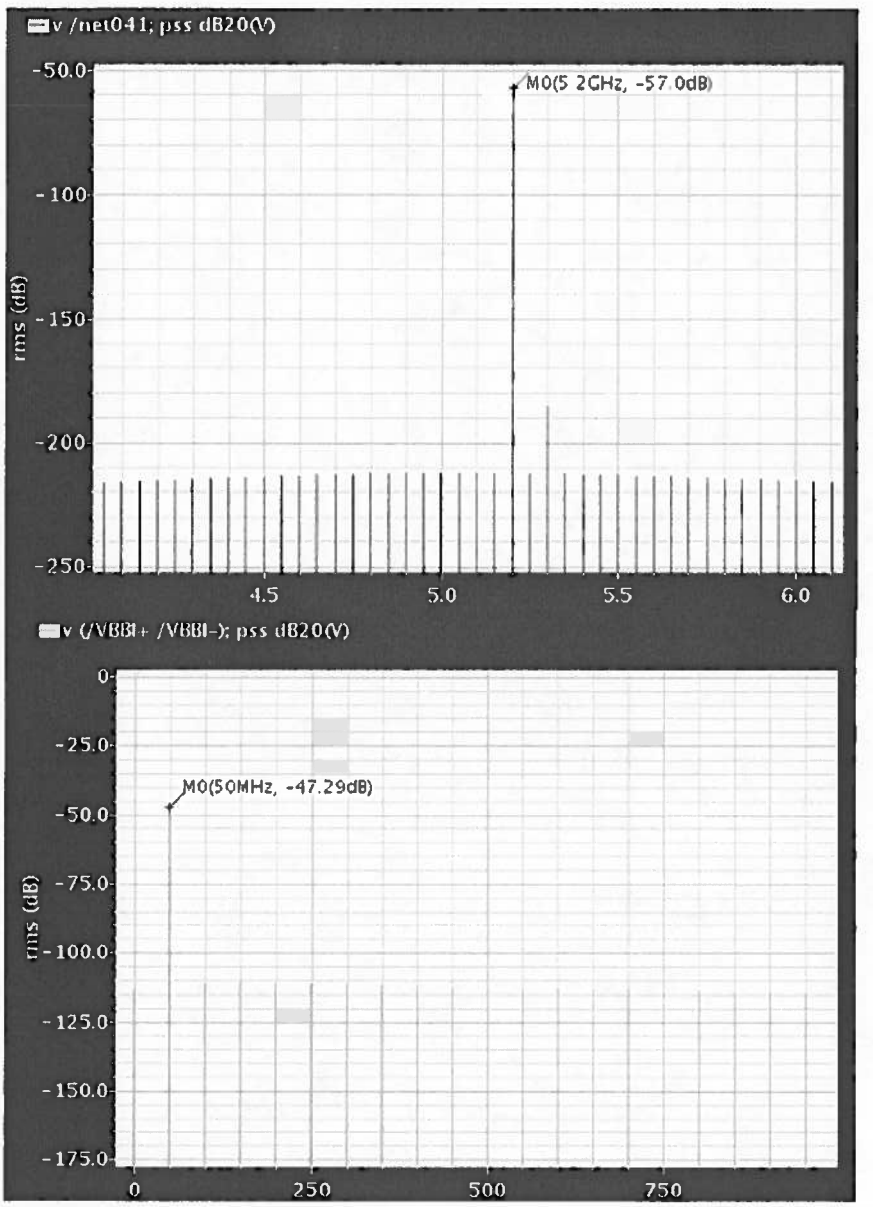
Rf mixer resonates at 1.7 GHz, as shown below.




b)The output is -47.29 dBV, the input Vin is -57 dBV, and voltage gain (with respect to Vin/2) is

-47.29 dBV-57 dBV+6 dB=15.7 dB

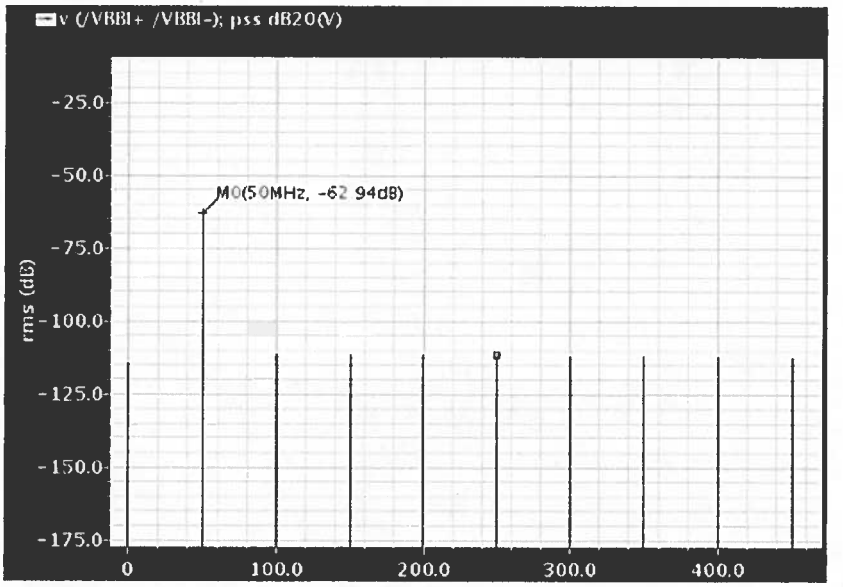
As plotted below




c)The image is at 3.5 GHz-(5.2 GHz-3.5 GHz)=1.8 GHz.

The image is filtered by the LC tank load of LNA. With the same input amplitude, the image at output is -62.94 dBV, and so image reject ratio is:

-47.29 dBV-(-62.94 dBV)=15.65 dB




d)The first mechanism of translating 8.7 GHz to baseband is mixing with the third-order harmonic of the LO in first mixer and then mixing with fundamental tone of LO in the second mixer:

3*3.5 GHz-8.7 GHz-1.75 GHz= 50 MHz

which is the baseband frequency.

The second mechanism is mixing with the fundamental tone of the first LO and then mixing with the third order harmonic of the second LO:

|8.7 GHz-3.5 GHz-3*1.75 GHz|=50 MHz

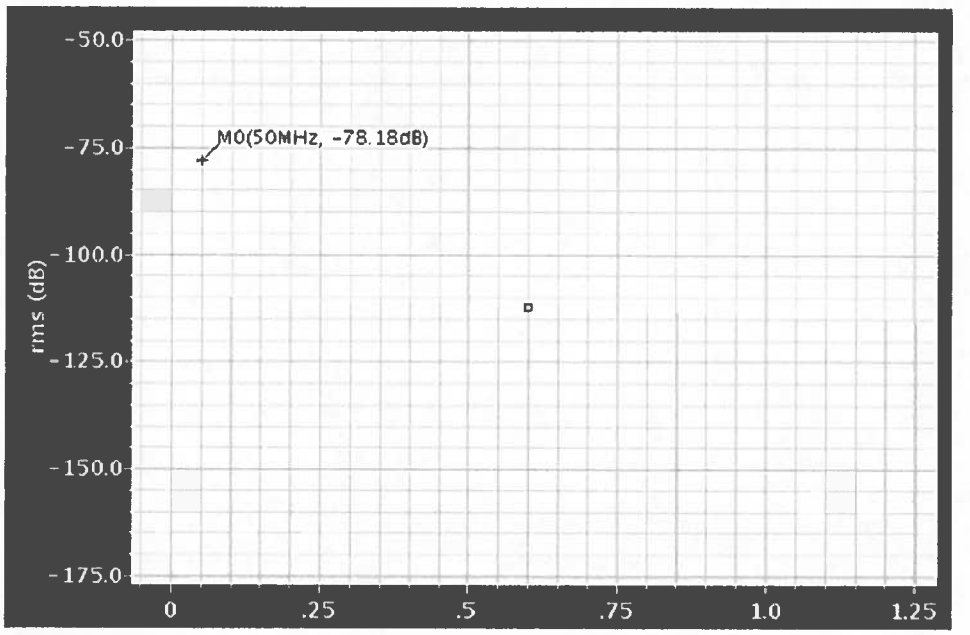
which is the baseband frequency.

With the same input amplitude, the output and baseband of 8.7 GHz input is -78.18 dBV, and so the gain is:

-78.18 dBV- (-57 dBV)+6 dB=-15.18 dB.

The normalized gain with respect to desired input is:

-15.18 dB-15.7 dB=-30.88 dB.


-50.0
-75.0
-100.0
-125.0
-150.0
-175.0
rms (dB)
M0(50MHz, -78.18dB)
0
.25
.5
.75
1.0
1.25