3ej4 Lab 4

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**Q1:**

1. Ad1 = 7.38dB, Ad2 = 70.05dB, Ad3 = 0dB
2. Ad = 77.43dB
3. V2 is the non-inverting input
4. Upper3-db frequency is about 6196Hz, where the phase change by 45 deg and the total gain reduce by 3dB

**Q2:**

In lab 3, the differential mode gain is 70.07dB. In Q1 lab4, the differential gain is 7.38dB. The reason that lab4 has a smaller frequency is, the input resistance of PNP Q3 become the load resistor RL at the output of stage 1. Since the RL is parallel with the original Rout of stage 1, the total output resistor decreases, and the gain decrease.

**Q3:**

Rin = 81.757kohm, Rout = 460.9ohm

**Q4:**

1. The following graphs are simulated Vo and measured Vo(blue) respectively.

图表, 折线图

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1. In simulation, Vpp = 3.996mV, Vp = 1.998mV, Vdc = 152mV

In measurement, Vpp = 3.98V, Vp = 1.992V, Vdc = 97mV

Since the input of simulation is 1mV, and that of measurement is 1V, we can see that the gain of both simulation and measurement are similar(A = Vp/Vin), so simulation and measurement are agree with each other. There is a slight difference in the Vdc, since the input of measurement will have the different offset of that at simulation, the difference in output offset is acceptable.

**Q5:**

1. The following graph are simulated result and measured result(blue) respectively

图形用户界面

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For simulated gain in V/V, the graph will be:

图表, 折线图

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Both simulated and measurement have similar gain of 2V/V (or 5dB) at low frequency.

1. To remain the gain at about 2V/V, the frequency is less than 312.6kHz in simulation, and 150kHz in measurement.

**Q6:**

This is negative feedback system because the negative input (Base of Q1) is directly connected to the output Vo with a 100K resistor in between. When input increase, the output also increase.

It is also a series-shunt system because it is a voltage-controlled voltage amplifier.

**Q7:**

**Q8:**

Using the voltage gain from question 1 A = 77.43dB = 7437.8V/V

Using the input resistance from Q1 Rid = 81.8kohm. ro = 461ohm, Rs = 0

Rout will be excluding RL,

**Q9:**

Since C1 = C2 = C, R3 = R4 = R.

Calculation:

The zero frequency:

Oscillator need |L(s)| larger than or equal to 1 at this frequency

**Q10:**

Characteristic Equation

Q pole for R2/R1 = 2:

Pole will be on jw axis if R2/R1 = 2, and be in the right half of s-plane for R2/R1>2. For R2/R1 = 2, Q = infinity.

Pole frequency can be solved by the real part:

**Q11:**

The setting time for 200koh, 240kohm, and 250kohm are 2.78ms, 1.21ms, and 0.64ms respectively. The setting time will increase with the decrease of R2 value. This is because with higher R2, the loop gain L(s) is higher, so the higher gain allows the voltage to quickly reach the maximum output 5V.

**Q12**

\*Please note I am not in Canada currently, so the amp I purchase my own may have slightly different from that at campus store.

In simulation, with 8.25kohm have about 18kHz ,and 4.02kohm have frequency about 35kHz. The calculation is based on the graph instead of real data. Uncertainty may apply.

图表, 直方图

描述已自动生成图表

描述已自动生成

In measurement, with 8.25kohm, the frequency is 16kHz. The theoretical frequency 1/(CR2pi) = 19.3kHz.

The values are close, so we see them agree each other. The slight difference may comes from uncertainty at capacitor, resistor, or scope since the time scale is small.

图表

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In measurement, with 4.02kohm, the frequency is 29kHz. The theoretical frequency 1/(CR2pi) = 39.5kHz.

The values are close, so we see them agree each other. The slight difference may come from uncertainty at capacitor, resistor, or scope since the time scale is small.

图表

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Both simulation and measurement result are less than the theoretical result because there might be resistivity and capacitance in the op-amp itself. Measurement are generally less than simulation because there is uncertainty in resistor, capacitor, op-amp and voltmeter.