3EJ4 Lab3

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*Part1:*

Text

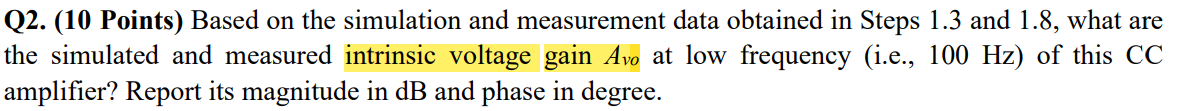
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(1)

Discuss/Justify: As the graph shown above, Vsig is the input voltage range from -5V to 5V with a 0.5V step. In order to let the common-collector work as an amplifier, the output voltage Vo should have an increasing trend as shown above with the corresponding Vsig change. Therefore, the Vsig range to ensure the circuit work as a CC amplifier is -4.5V to 5.0V.

(2) To ensure the circuit work as a common-collector amplifier, Vsig should in the range of -4.5V to 5.0V and the output voltage Vo should be greater in the range of -4.683226V to 4.447137V.

(3) The Vsig values results in Vo = 0V is Vsig = 0.5V.



The simulated intrinsic voltage gain Avo at low frequency is 0dB with phase -8.47E-5deg.

The measured intrinsic voltage gain Avo at low frequency is 0.8dB with phase 0deg.

*Part2:*

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(1) According to the Section 8.2.3 in the textbook as shown below,

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Since we are using the same two BJTs, the EBJ area of Q2 and Q1 should be the same. So, the relationship of Io and Iref is Io = Iref. Their ratio is equal to 1.

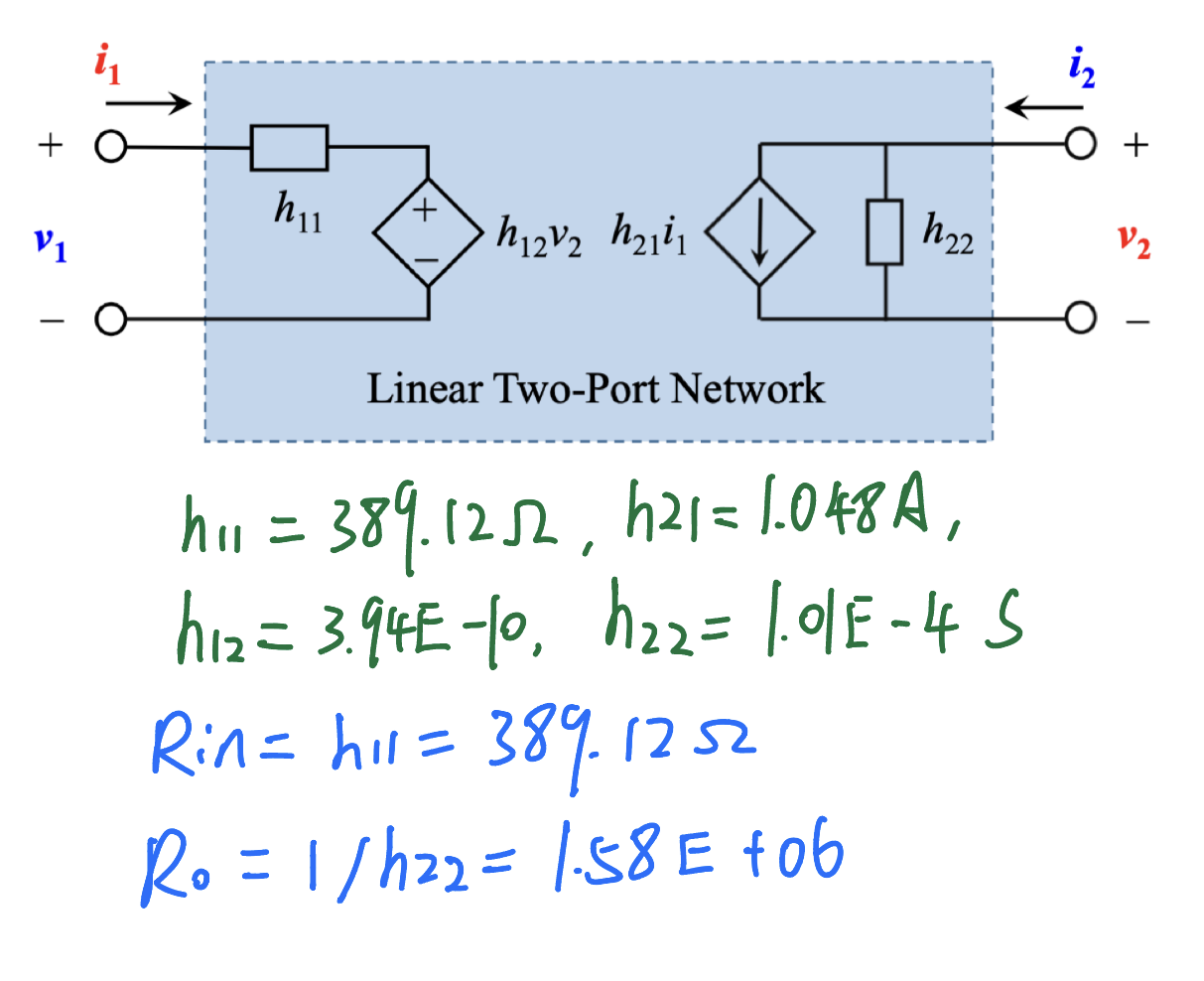
(2) As the below IRef and Io relationship graph shown below, the IREF and Io is nearly the same when they Iref is 0.1mA and 1mA.

(3) Based on the derivation formula that Iref=Io since they are using the same BJTs with equal EBJ area, the simulation result of IRef in the range from 0.1mA and 1mA proves the theoretical prediction which they are forming a current mirror with same current.

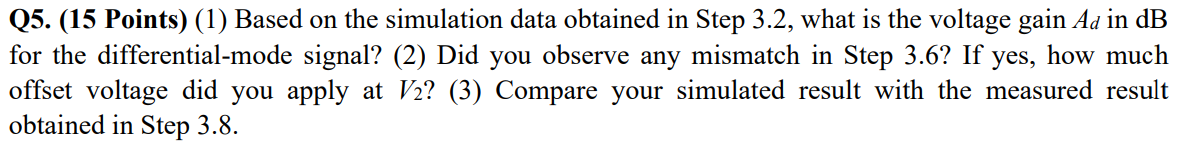
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1. Input impedance Rin = 389.12ohm. The current gain Ai = 1.048.
2. Output impedance Ro = 1.58E+06ohm.



*Part3:*



1. The voltage gain is 78.11dB.

Table

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1. Yes, the offset I applied at V2 is -0.00065V.Graphical user interface, text, application, Word

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2. The simulated result is 58.94dB and the measured result is 56.2dB which they are close enough.

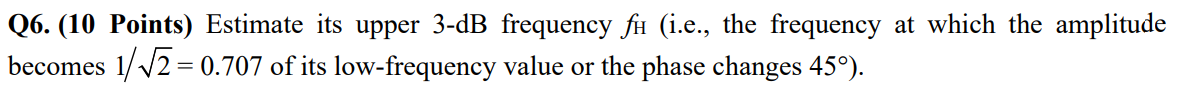


Graphical user interface

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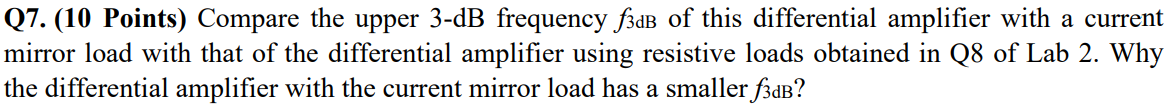
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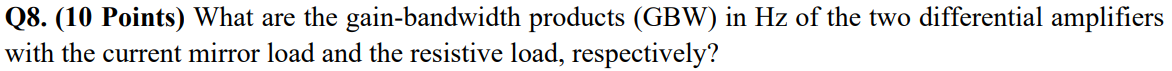


The upper 3-dB frequency should around 1.54E+04 hz which will have the Vm(vo) amplitude close to 11.37861354V.





The upper 3-dB frequency is 5655555.22514252Hz from question (8) of lab2 by using the differential amplifier. The upper 3-dB frequency from Q6 is around 15400Hz. The reason of the differential amplifier with the current mirror load has a smaller f3dB is because the differential amplifier using resistor loads has the gain Ad is 19.63dB and the differential amplifier using current mirror load has the gain Ad of 78.11dB. According to the Miller Theorem, the higher of the voltage gain gmRl’, the larger of of τgd due to the Miller effect which results in the lower of the upper 3-dB frequency f3dB.



The GBW for the current mirror and resistive load is 9.01E+07 and 1.07E+05 separately as shown below. It is calculated by using the formula = (low frequency)Vm(Vo) / 0.002\*11200.

Table

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