3EJ4 LAB THREE

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Questions for Part 1:

Q1.

(1). The relationships between VO and Vsig are almost like linear relationships for both the simulated and measured data given in the below plots.

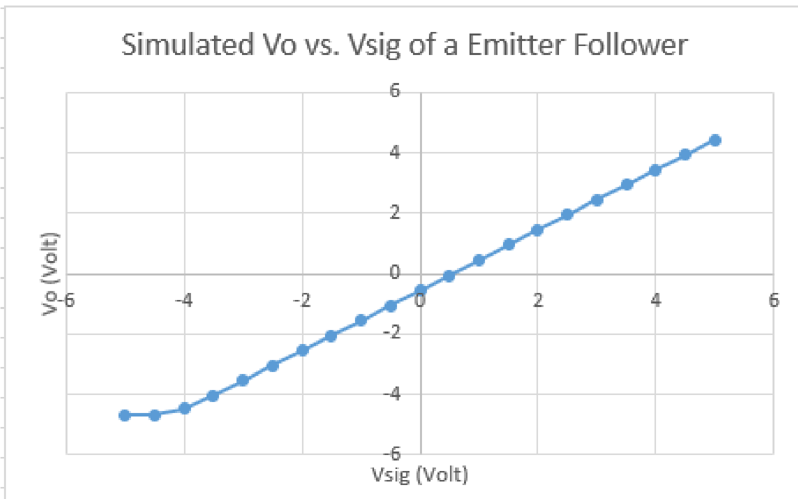

Fig (1.1) The Simulated V_o vs. V_{sig} characteristics

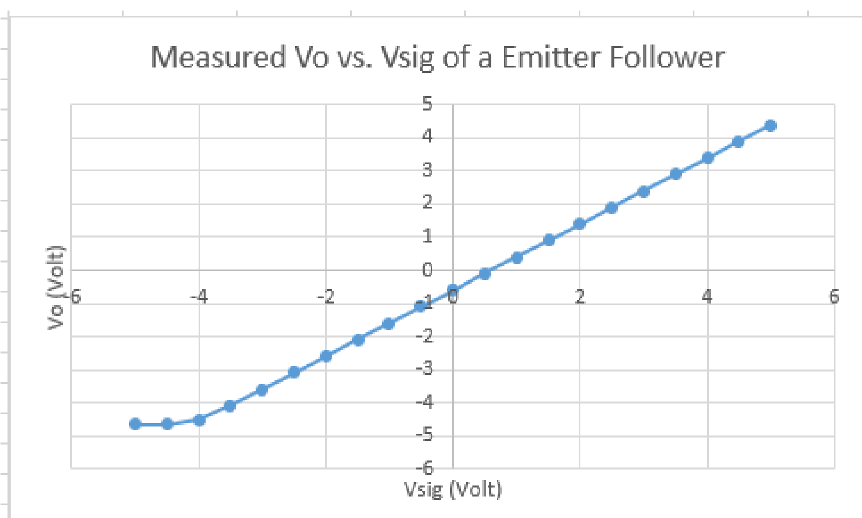

Fig (1.2) The measured V_o vs. V_{sig} characteristics

(2). From the simulation data, the DC input range for V_{sig} is from -4.5V to 4.5V. The output voltage range for V_o is from -4V to 5V. In addition, from the measurement data, the DC input range for V_{sig} is from -4.5V to 4.5V. The output voltage range for V_o is from -4V to 5V.

(3). V_{sig} is 0.5 V when V_o is around 0 V.

Q2.

Based on the simulation data in Steps 1.3, the simulated intrinsic voltage gain A_{vo} at low frequency (i.e., 100HZ) of this CC amplifier is 0.00 dB.

Based on the measurement data in Steps 1.8, the measured intrinsic voltage gain A_{vo} at low frequency (i.e., 100HZ) of this CC amplifier is 0.8 dB.

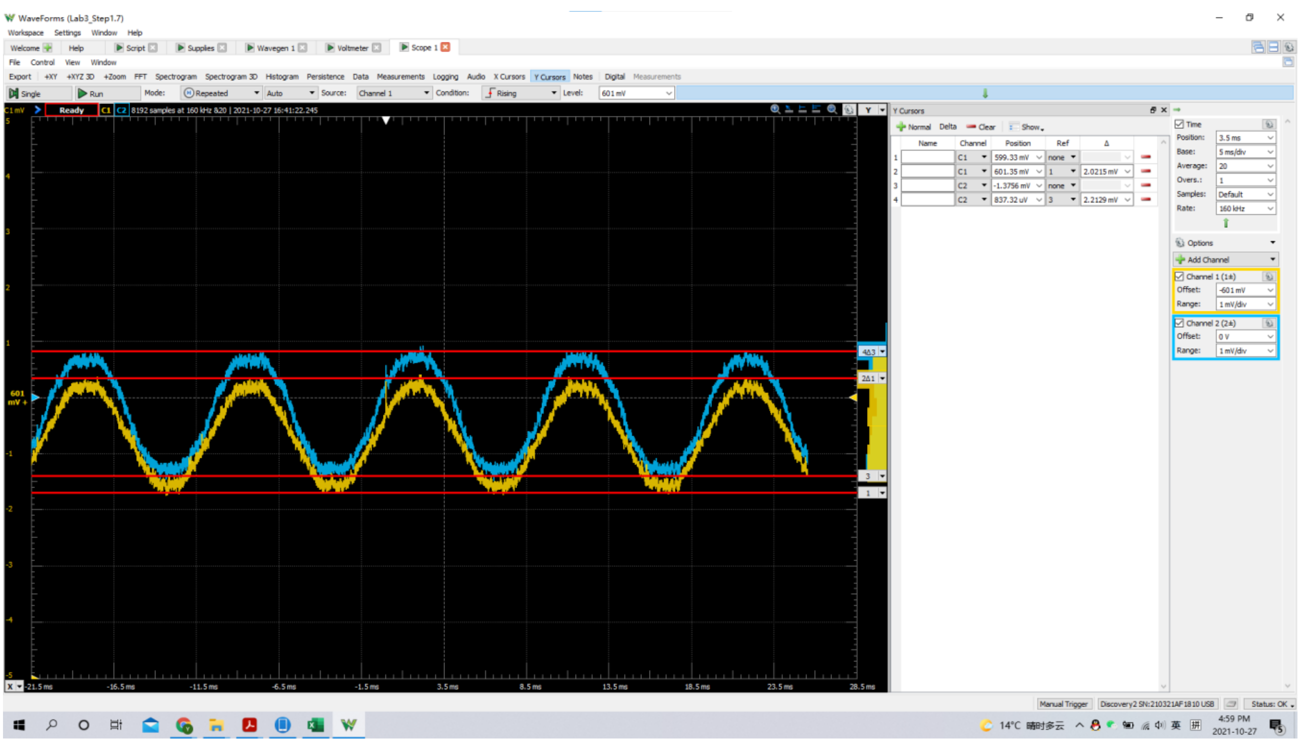

Fig 1.3(for 1.8)

Questions for Part 2:

Q3.

(1). The relationship between I_o and I_{REF} relies on the EBJ area of the two BJTs. I_o is the same with $I_{REFF,}$ which is $I_o = I_{REF}$.

(2). When I_{REF} is 0.1mA, I_o is 0.104mA which equals $0.104I_{REF}$. When I_{REF} is 1mA, I_o is 0.975mA which equals $0.975I_{REF}$.

(3). The values of I_o at I_{REF} are 0.1mA and 1 mA which are 0.104 I_{REF} and $0.975I_{REF.}$ Since the simulated results show that I_o roughly equals I_{REF}, the theoretical predication and simulated results are extremely similar.

Q4.

(1). The input impedance R_{in} is 389.12Ω. The current gain A_i is 1.042.

(2). The output resistance R_o is 1.58MΩ.

(3). The linear two-port network for the current using its h-parameters is shown below in Fig(4.1).

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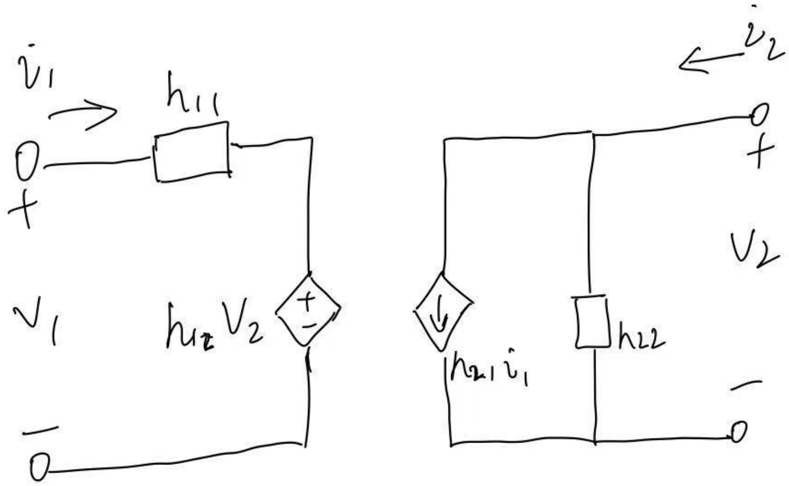

$$h_{11} = R_{in} = 389.12\,\Omega$$

$$h_{22} = 1/R_o = 6.33\times10^{-7}\,S$$

$$h_{21} = A_i = 1.042$$

$$h_{12} = \frac{V_{in}}{10^{-6}} = \underset{(100Hz)}{7.05\times10^{-7}} \sim \underset{(200Hz)}{1.41\times10^{-6}}$$

Fig(4.1)

Questions for Part 3:

Q5.

(1). Based on the simulation data obtained in Step 3.2, the voltage gain A_d is 69.95dB.

(2). There was a little mismatch. The offset voltage applied at V_2 was 5.25mV.

(3). My simulated result is 69.95dB in Step3.2, which is larger than my measured result,49.6dB in step 3.8.

Q6.

The upper 3-dB frequency f_H is approximately 29.197KHZ by looking through the Step3.2.

Q7.

The upper 3-dB frequency f_{3dB} of the differential amplifier using resistive loads in Lab 2 was 8.145 MHz, which is greater than the differential amplifier with a current mirror in this Lab 3. Since the internal capacitive effects of the BJTs used in the current mirror load, the differential amplifier with the current mirror load has a smaller $f_{3dB.}$

Q8.

The gain-bandwidth product of the differential amplifier with the current mirror load is 3.52*10^7 HZ , while the gain-bandwidth product of the differential amplifier with the resistive load is 7.95*10^7HZ .

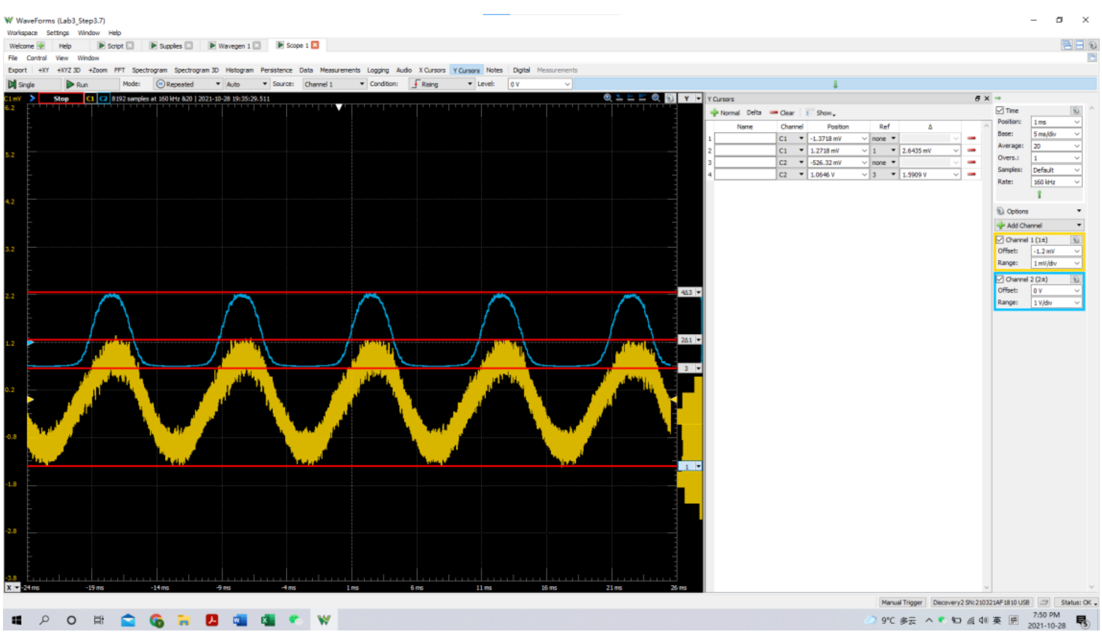

Fig 8.1(for 3.8)

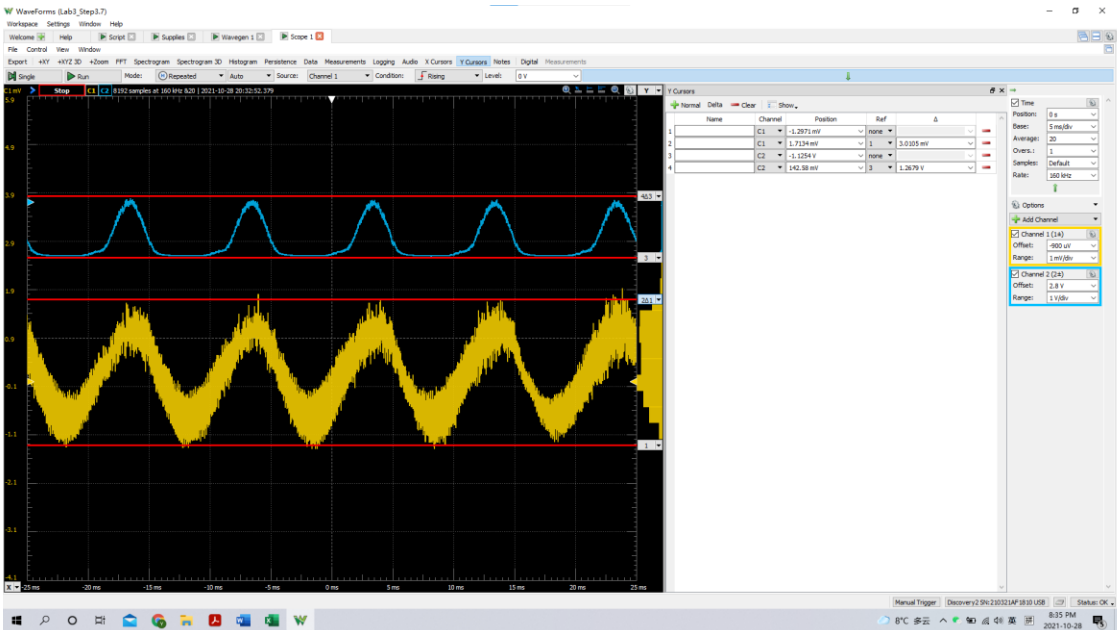

Fig 8.2(for 3.9)