電子電路實驗 5: Differential Amplifiers

實驗預報

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1 Objectives

1. To be familiar with the characteristics of differential amplifiers
2. To comprehend the importance of CMRR (Common Mode Rejection Ratio) of an amplifier.

2 Procedures

2.1 Differential Mode Small Signal Analysis

1. Use 10 kΩ variable resistance for R_{C1}, R_{C2}, R', and $R_S1 = R_S2 = 0$ in Fig. 5.
2. Provide voltage source $V_{CC} = +12V$, and $V_{SS} = -6V$ to the circuit.
3. Provide voltage source $V_{SS} = -6V$ to pin 13 of each chip of CA3046.
4. Oscilloscope ▷Press the CH1 and CH2 MENU ▷Coupling ▷AC.
5. Oscilloscope ▷Press the DISPLAY button ▷Format ▷YT mode.
6. Oscilloscope ▷Press the Measure button ▷Observe $V_i(p-p)$ in CH1.
7. Use the function generator to provide the input small signal V_i and make sure that $V_i = v_{ac}sin(2\pi ft)$, $2v_{ac} = 20mV(p-p)$, f = 1~5kHz is measured from the breadboard by using CH1 of oscilloscope to observe.
8. Keep the previous adjustment of V_i constantly, and do not adjust the amplitude tuner in function generator any further.
9. Oscilloscope ▷Press the Measure button ▷Observe V_{O1} (p-p) and V_{O2} (p-p) in CH1 and CH2 at YT mode.
10. Adjust the variable resistance of R' so that voltage gain could be as high as possible.

11. Adjust the variable resistance of R_{C1} and R_{C2} so that A_{d1} voltage gain could be equal to A d2 .
12. If $V_o = 0$, that is, there is no output signal, try to generate the input small signal v_i as $v_i = v_{ac}sin(2\pi ft)$, $2v_ac = 2V$ (p-p) , $f = 1$~$5kHz$, and repeat step (10) (11).
13. Record A_d:
14. Function generator ▷Press the FUNC button ▷Reducing Frequency and observe the voltage gain $A_{V_{in}}$ oscilloscope until $A_V = 0.707A_d$.
15. Function generator ▷Press the FUNC button ▷Increasingly adjust the Frequency and observe the gain $A_{V_{in}}$ oscilloscope until $A_V = 0.707A_d$..
16. Record the frequency
17. Change the frequency of small-signal input voltage, and record the input

2.2 Common Mode Small Signal Analysis

1. Keep the previous adjustment of R_{C1}, R_{C2} and R' constantly. Use function generator to provide $v_i = v_{ac}sin(2\pi ft)$, $2v_{ac} = 1\,\text{V}$ (p-p) , $f = 1$~$5kHz$.
2. Oscilloscope ▷Press the Measure button ▷Observe V_{O1} (p-p) and V_{O2} (p-p) in CH1 and CH2 at YT mode.
3. Record A_{cm}
4. Function generator ▷Press the FUNC button ▷Reducing Frequency and observe the voltage gain $A_{V_{in}}$ oscilloscope until A_V(Low-3dB) $= 0.707A_{cm}$.
5. Function generator ▷Press the FUNC button ▷Increasingly adjust the Frequency and observe the gain $A_{V_{in}}$ oscilloscope until A_V(High-3dB) $= 0.707A_{cm}$.
6. Record the frequency.
7. Change the frequency of small-signal input voltage, and record the input and output voltage shown in oscilloscope to the following table.

2.3 Completed Mode Small Signal Analysis

1. Keep the previous adjustment of R_{C1} , R_{C2} and R' constantly. Use the function generator to provide: (a) $V_{id} = v_{ac}sin(\omega t), 2v_{ac} = 20mV$ (p-p) , and (b) $V_icm = v_{ac}sin(2\pi ft), 2v_{ac} = 1\,\text{V}$ (p-p) , $f = 1$~5 kHz.
2. Oscilloscope ▷Press the Measure button ▷Observe V_{O1} (p-p) and V_{O2} (p-p) in CH1 and CH2 at YT mode.
3. Record $A_d, A_{d1}, A_{d2}, A_{cm}, V_{O1}, V_{O2}$
4. Function generator ▷Press the FUNC button ▷Increasingly adjust the Frequency and observe the gain $A_{V_{in}}$ oscilloscope until A_V (High-3dB) $= 0.707A_{cm}$.
5. Record the frequency.

6. Change the frequency of small-signal input voltage, and record the input and output voltage shown in oscilloscope to the following table.