電子電路實驗 4: Single-Stage BJT Amplifiers

實驗預報

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1 Objectives

1. To analyze the dc bias from the device characteristic, and derive device parameters for BJT.
2. Design the CE (Common Emitter, CE) amplifier by using the small-signal model.
3. Measuring the fundamental characteristic, gain, bandwidth and resistance of BJT and confirm the measured data with those in 2.

2 Procedures

2.1 Small-signal analysis

1. In Fig. 2, use 10 kΩ variable resistance for $R_1, R_2, R_C, R_E, R_S = 0, R_L = \infty$.
2. Supply DC voltage source $V_{CC} = +9\,\mathrm{V}$ to the circuit.
3. Provide the input small signal V_i to the breadboard by using function generator to generate $V_i = v_{ac}\sin(2\pi ft), 2v_{ac} = 20\,\mathrm{mV}$, $f = 10\tilde{}20\mathrm{kHz}$.
4. Make sure that the v_i is measured from the breadboard by using the probe from CH1 in oscilloscope.
5. Function generator ▷Press the `FUNC` button ▷Set `FREQ` = 10˜20kHz, `SIN` wave ▷`ATTN` 40 dB.
6. Oscilloscope ▷Press the `CH1` and `CH2` `MENU` ▷`Coupling` ▷`AC` .
7. Oscilloscope ▷Press the `Measure` button ▷Observe $V_{(p-p)}$ in `CH1` and `CH2` .
8. Adjust the variable resistance of R_1, R_2, R_C and R_E so that voltage gain could be reached to $A_M = 100\,\mathrm{V/V}$.

9. Record the voltage gain: V/V by observing the differentiation of input and output voltage peak-to-peak value shown in the curve at `YT` mode.
10. Function generator ▷Press the `FUNC` button ▷Adjust Frequency and observe the voltage gain A_V in oscilloscope until $A_V = 0.707 A_M$.
11. Record the frequency: $f_{L(a)}$
12. Using the principle of major pole, change the value of C_2 until $f_L = 100\,\text{Hz}$.
13. Record the value of C_2.
14. Change the frequency of input voltage signal, and record the input and output voltage shown in oscillos cope to the following table Keep the previous adjustment consta nt, and DO NOT disconnect the signal input from functional generator.
15. Use multi-(RLC) meter to measure the following values: $R_{B1}, R_{B2}, R_C, R_E, V_E, V_C, V_B$, $I_E, I_C, I_B = I_E - I_C, \beta$.

2.2 Measuring small-signal input and output resistance

1. In Fig. 3, use $10\,\text{k}\Omega$ variable resistance for R_V .
2. Adjust R_V so that the measured peak-to-peak voltage value in "oscilloscope node" of Fig. 3 is half of V_i .
3. Record the value of $R_V = R_i$.
4. In Fig. 4, use $10\,\text{k}\Omega$ variable resistance for R_V .
5. Adjust R_V so that the measured peak-to-peak voltage value in "oscilloscope node" of Fig. 4 is half of V_O .
6. Record the value of $R_V = R_O$